Honolulu High-Capacity Transit Corridor Project

Final Model Development, Calibration, and Validation Report

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Acronyms and Abbreviations

AA	Alternative Analysis
AMC	Ala Moana Center
ARRF	Aggregate Rail Ridership Forecast
BPR	Bureau of Public Roads
bus-off	bus stop off—location where a rider gets off a bus
bus-on	bus stop on—location where a rider gets on a bus
CBD	Central Business District
CTPP	Census Transportation Planning Package
DBEDT	Hawai'i Department of Business, Economic Development and Tourism
DEIS	Draft Environmental Impact Statement (abbreviation used in table headings only)
EIS	environmental impact statement
FTA	Federal Transit Administration
GIS	geographic information systems
GLA	gross leasable area
GPS	Global Positioning System
HBO	home-based-other
HIS	home interview survey
HOT	high-occupancy toll
HOV	high-occupancy vehicle
ITE	Institute of Transportation Engineers
IVT	in-vehicle time
JAW	journey-at-work
JAW-AN	journey-at-work—non-home-based
JAW-AW	journey-at-work—work-based
JTW	journey-to-work
JTW-WH	journey-to-work—home-based-work
JTW-WN	journey-to-work—non-home-based
JTW-WO	journey-to-work—home-based-other
JTW-WW	journey-to-work—work-based
KNR	kiss-and-ride

MOSL	First Project Salt Lake Alternative
mph	miles per hour
NC	non-work-related—home-based-college
NK	non-work-related—home-based-school (K-12)
NN	non-work-related—non-home-based
NO	non-work-related—home-based-other
NS	non-work-related—home-based-shopping
O‘ahuMPO	O‘ahu Metropolitan Planning Organization
OBS	on-board survey
PNR	park-and-ride
RTD	Rapid Transit Division
SOV	single-occupant vehicle
TAZ	transportation analysis zone
TOD	time of day
TSM	Transportation System Management
UH Mānoa	University of Hawai‘i at Mānoa
V/C	volume to capacity
VDF	volume delay function
VHT	vehicle hours traveled
VMT	vehicle miles traveled
VOT	value of time
WMATA	Washington Metropolitan Area Transit Authority

1 Introduction

The City and County of Honolulu Department of Transportation Services Rapid Transit Division (RTD), in cooperation with the Federal Transit Administration (FTA), is preparing a Draft Environmental Impact Statement (EIS) to identify and evaluate high capacity transit service improvements along a corridor between Kapolei and the University of Hawai‘i at Mānoa (UH Mānoa). This report describes the travel forecasting methods, assumptions, and supporting analytical procedures that will be applied in the analysis and evaluation of transit alternatives under consideration. These methods are a result of detailed discussions with FTA on model improvements needed to produce a more accurate forecast for high-capacity transit service on O‘ahu.

The methodology report is an evolving document that provides discussion of the technical approach to the travel forecasting effort. Specifically, it describes modifications to the O‘ahu Metropolitan Planning Organization’s (O‘ahuMPO) current travel demand model for use in producing Draft EIS baseline and future year forecasts for various transit alternatives for the Honolulu High-Capacity Transit Corridor Project. Consequently, the material contained in the deliverables should be considered as work in progress. It is subject to revision as comments are received and responded to by project staff. It may be superseded as a result of subsequent activities.

2 Model Overview

The O'ahuMPO "best-practice" models have adopted the general structure that has been used for several decades for urban travel models in the United States. All model sets that have been developed recently in several urban areas have continued to use this "sequential" approach to travel forecasting in which travel patterns are assumed to be the product of a sequence of individual decisions:

- The number of trips that a household will make—*trip generation*
- The destinations of these trips—*trip distribution*
- The modes that will be used for travel—*mode choice*
- The paths on the network that the trips will take—*network assignment*

The various travel models used by O'ahuMPO and the operation of the model, as well as input and output files are described in the *Guide to Model Form*.

Figure 2-1 shows the sequence of model procedures in flow chart form of the current O'ahuMPO models.

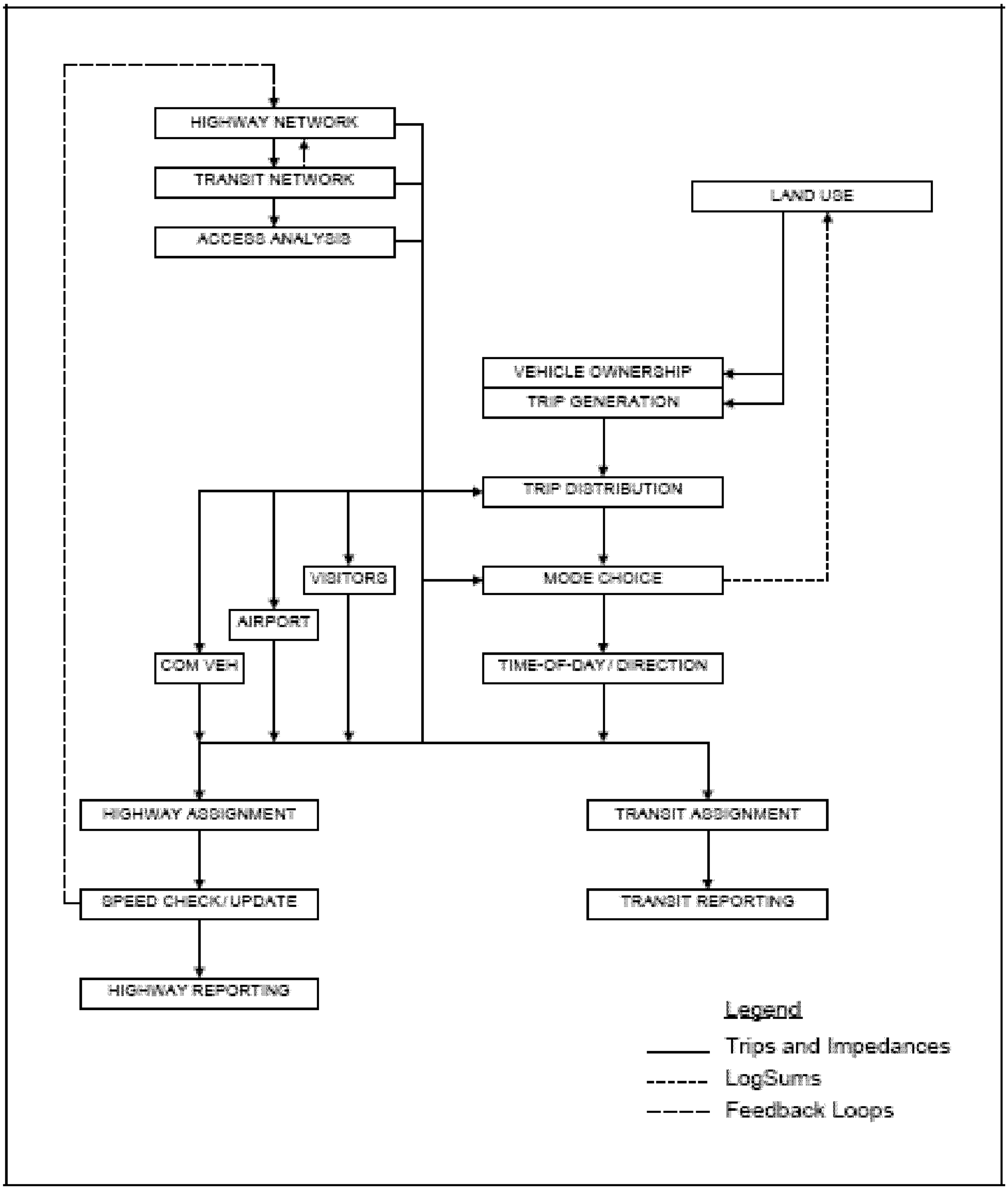

Figure 2-1: O‘ahu Travel Demand Model Flow

3 Model Refinement and Calibration

The following activities were undertaken as part of the review, enhancement, and recalibration of the existing O'ahu models. These refinements were necessary to provide a more accurate forecast of transit alternatives. They have been grouped into the following categories for ease of discussion in the later sections. Each section discusses the calibration/validation of that particular model revision. The last section discusses in more detail a few more substantial revisions and calibration/validation efforts for the travel model.

- Data Analysis and Comparisons
  - Ala Moana Center (AMC) on-board survey (OBS) analysis
  - Transit OBS analysis
  - Auto-ownership versus Census Transportation Planning Package (CTPP) comparison
  - Analysis of highway travel time by traffic group
  - Tests of alternative highway volume—delay functions
  - Review of transit travel time functions
  - Examination of variations in speed table/free flow speed assumptions
  - Evaluation of parking cost representation and forecasting
  - Year 2000 CTPP person trip matrix comparisons
- Refinement of Model Purposes
  - Revision of home-based school (K-12) and home-based college distribution
  - Update of visitor model
  - Evaluation of singly constraining shopping purpose
  - Trip generation model—Ala Moana factor
- Mode Choice Adjustments
  - Adjustment of mode choice model
  - Implementation of new informal park-and-ride process
  - Implementation and testing of a toll choice component for the mode choice model
- Update to Walk Access Links Process
  - Drive Access link program (DRVLINKS) revisions
  - Manual adjustment of walk access links
  - MINUTP access link limitations

- Other
  - Zone and district system change to 764 and 26
  - Land use changes
  - Non-home-based (NHB) direct demand model-calibration and development
  - Fare change
  - Non-included attributes
- Calibration and Validation
  - Calibration target values
  - San Diego method for kiss-and-ride (KNR) and park-and-ride (PNR)
  - Aggregate Rail Ridership Forecast (ARRF) model comparison

3.1 Data Analysis and Comparisons

3.1.1 Ala Moana Center On-board Survey Analysis

The FTA voiced concern over the increase in trips to AMC—in particular, that the 2005 OBS showed a higher percentage of trips (20 percent) to the AMC district than in the previous 1992 OBS (16 percent). The AMC Zone attracted 11 percent of the transit trips in 2005 as opposed to 7 percent in 1992. Moreover, the 2005 OBS showed a lower percentage of trips (6 percent) to the Waikīkī district than the previous 1992 OBS (10 percent). Downtown also showed a lower percentage of transit trips (21 percent) compared to the 1992 survey (26 percent). These data comparisons raised concern that the 2005 survey results had been tabulated incorrectly or that, perhaps, the recorded passenger responses were not actually destinations at Ala Moana but instead transfers to/from other buses at AMC. The analysis performed on trips to AMC is detailed in this section.

Table 3-1 shows that 58 percent of all trips to District 3 (AMC district) were to Zone 186 (AMC zone). 35 percent of the trips to Ala Moana zone came from District 4, Waikīkī. The 1992 survey indicated only 26 percent of the trips to AMC came from Waikīkī.

Table 3-1: 2005 On-Board Survey Trips Attracted to Ala Moana Center and District 3

Production District	Trips to Zone 186	Trips to District 3	% of Trips to Zone 186	% of Ala Moana Trips
1. Ward-Chinatown	1,074	2,689	40%	5%
2. Kakaʻako	362	476	76%	2%
3. Punchbowl-Sheridan-Date	734	2,068	36%	4%
4. Waikīkī	7,034	8,689	81%	35%
5. Kāhala-Tantalus	1,122	2,522	44%	6%
6. Pauoa-Kalihi	1,659	2,880	58%	8%
7. Iwilei-Māpunapuna-Airport	1,701	2,406	71%	8%
8. Hickam-Pearl Harbor	411	483	85%	2%
9. Moanalua-Hālawa	487	987	49%	2%
10. ʻAiea-Pearl City	871	1,608	54%	4%
11. Honouliuli-ʻEwa Beach	279	499	56%	1%
12. Kapolei-Ko ʻOlina-Kalaeloa	143	337	42%	1%
13. Makakilo-Makaiwa	66	117	56%	0%
14. Waipahu-Waikele-Kunia	669	1,228	54%	3%
15. Waiawa-Koa Ridge	8	27	31%	0%
16. Mililani-Melemanu-Kīpapa	119	223	53%	1%
17. Wahiawā-Whitmore-Schofield	223	758	29%	1%
18. East Honolulu	147	1,249	12%	1%
19. Kāneʻohe-Kahaluʻu-Kualoa	347	462	75%	2%
20. Kailua-Mōkapu-Waimānalo	271	505	54%	1%
21. Koʻolauloa	281	325	86%	1%
22. North Shore	40	96	42%	0%
23. Waiʻanae Coast	262	365	72%	1%
24. Mānoa-Tantalus	1,676	3,598	47%	8%
25. University	391	793	49%	2%
Total	***20,379***	***35,392***	***58%***	***100%***

Table 3-2, item 6, shows that of those trips from Waikīkī, only 310 (expanded) trips transferred, meaning that potentially these records should not have Ala Moana as their final destination.

Table 3-2 also shows that of all the trips with AMC as an origin, only 114 trips used Route 8 when Waikīkī was NOT the destination. This is also a potential record error since Route 8 ONLY goes to Waikīkī from AMC.

Table 3-3 shows only 17 percent of all trips produced from District 3 (Ala Moana district) are from the AMC zone. And most of these trips were attracted to the Ward-Chinatown district (44 percent).

These tables reflect some of the differences between the surveys and thus require the survey data to be reviewed to ensure that the records are correctly reflected. The survey data was grouped into categories by flagging bus routes that connect directly to AMC—either "at AMC" for routes on Ala Moana Boulevard or Kona Street or "near AMC" for routes on Kapiʻolani Boulevard. Survey riders could have written down up to four routes they took in sequence to get to AMC. If none of the routes listed connected at or near AMC, they were flagged as suspect records. This is a problem because an AMC origin or destination might be hard to reach given the bus routes listed by the respondent. If only one of the routes listed went by AMC, this record was considered acceptable. If more than one of the routes listed connected to AMC, it was flagged as a possible issue because the reported path might have included a transfer at AMC rather than AMC as the true origin or destination.

Table 3-2: Analysis of 2005 On-board Survey Trips to/from Ala Moana Center Zone

Item	Number of Observations	Number of Linked Trips
1—Total in survey dataset	14,609	178,121
2—Number with Ala Moana as destination	1,048	12,243
3—Number of item 2 that did NOT transfer	693	9,938
4—Number with Ala Moana as origin	712	11,157
5—Number of item 4 that did NOT transfer	371	9,477
6—Number of item 2 that TRANSFERRED and had Waikīkī as the origin	32	310
7—Number of item 2 that TRANSFERRED, Waikīkī was NOT the origin, and one of the bus sequence routes was Route 8	35	159
8—Number of item 4 that TRANSFERRED and had Waikīkī as the destination	18	129
9—Number of item 4 that TRANSFERRED, Waikīkī was NOT the destination, and one of the bus sequence routes was Route 8	35	114
10—Number of item 2 that TRANSFERRED, had Origin between Hawaiʻi Kai and Middle Street, and one of the bus sequence routes was a community circulator in the 400s (Leeward Community Circulators)	8	12

Table 3-3: 2005 On-board Survey Trips Produced from Ala Moana Center and District 3

Attraction District	Trips from Zone 186	Trips from District 3	% of Trips from Zone 186	% of Ala Moana Trips
1. Ward-Chinatown	1,332	6,718	20%	44%
2. Kakaʻako	183	841	22%	6%
3. Punchbowl-Sheridan-Date	55	2,068	3%	2%
4. Waikīkī	96	1,110	9%	3%
5. Kāhala-Tantalus	122	851	14%	4%
6. Pauoa-Kalihi	107	607	18%	4%
7. Iwilei-Māpunapuna-Airport	119	872	14%	4%
8. Hickam-Pearl Harbor	16	589	3%	1%
9. Moanalua-Hālawa	—	146	0%	0%
10. ʻAiea-Pearl City	417	993	42%	14%
11. Honouliuli-ʻEwa Beach	12	14	86%	0%
12. Kapolei-Ko ʻOlina-Kalaeloa	26	65	40%	1%
13. Makakilo-Makaiwa	—	2	0%	0%
14. Waipahu-Waikele-Kunia	30	262	12%	1%
15. Waiawa-Koa Ridge	—	—	0%	0%
16. Mililani-Melemanu-Kīpapa	—	14	0%	0%
17. Wahiawā-Whitmore-Schofield	1	5	20%	0%
18. East Honolulu	29	524	5%	1%
19. Kāneʻohe-Kahaluʻu-Kualoa	33	223	15%	1%
20. Kailua-Mōkapu-Waimānalo	15	218	7%	0%
21. Koʻolauloa	15	18	84%	0%
22. North Shore	5	20	26%	0%
23. Waiʻanae Coast	30	61	49%	1%
24. Mānoa-Tantalus	23	177	13%	1%
25. University	357	1,153	31%	12%
Total	***3,022***	***17,547***	***17%***	***100%***

For some flagged records in which more than one route went by AMC, it was discovered the routes listed were routes that the traveler could use for the trip. For example, one record lists a trip to AMC that reports Routes C, 40, and 93 were used. But all three routes connect the Wai‘anae coast with Downtown (C and 40 both go to AMC, while 93 goes to the government center or thereabouts). It seems as though the traveler was attempting to report the three different buses that he/she could take, perhaps depending on which one arrived first at the origin-end bus stop. These records were reviewed manually to determine if the origin and destinations made sense and there were multiple buses that could provide that access. These were fixed and deemed acceptable records.

Table 3-4 shows the breakdown of the records that were determined to possibly be suspect in the OBS.

Table 3-4: Breakdown of Suspect Records

Code Description	Listed Bus Routes Do Not Pass AMC	More than 1 Bus Connects near or at AMC
Total records	121	392
Number of trips expanded for total records	1729	2138
Number records OK because route verified to pass AMC	50	
Number of suspect records	71	
Number of suspect records really NOT Ok	30	
Number of expanded trips for suspect NOT Ok records	347	
Number of records with AMC as origin		200
Number of expanded trips for records listed above		976
Number of records with AMC as origin and are suspect after looking at bus sequence, bus-on, destination address, mode of access and egress, and number of blocks walked on access/egress end		71
Number of expanded trips for records listed above		283
Number of records with AMC as origin and are OK given bus sequence variable, bus-on, destination address, mode of access/egress, number of blocks walked on access/egress end		129
Number of expanded trips for records listed above		693
Number of suspect records that are of AMC origin, Route 8 was one of the sequence of routes, and Waikīkī was not the destination		35
Number of expanded trips for records listed above		122
Number of records with AMC as destination		192
Number of expanded trips for records listed above		1162
Number of records with AMC as destination, and Route 8 was one of the sequence of routes but Waikīkī was not the Origin		29
Number of expanded trips for records listed above		114

The described flagging process found 121 records where none of the bus routes listed by the respondent actually went to AMC. Manual verification of these records found that 50 records had a valid route that went by AMC on the route they were surveyed, but it wasn't displayed properly by the route that was listed. Only 71 of the flagged records were actually suspect. Of those 71 records, 30 had Ala Moana entered as their origin or destination when the bus stop on (bus-on) (location where a rider gets on a bus) verified they got on/off somewhere else or they might have transferred from another route and didn't accurately record that on the survey. These surveys were fixed and the others were deleted because logical routes could not be determined.

There were 392 records that had more than one route listed by the respondent that could pass by AMC. Of these 392 records, 200 records listed AMC as the origin and 192 records listed Ala Moana as the destination. Since the district-to-district summary of the OBS showed that there were more attractions to Ala Moana and less attractions to Waikīkī in the 2005 survey as compared to the 1992 survey, the analysis focused on trips that could have transferred through Ala Moana from or to Waikīkī. By manually looking at the record's bus sequence variable, bus-on, destination address, mode of access/egress, number of blocks walked on access/egress end, it was determined that 129 of these records did indeed originate at AMC and were correctly coded in the survey.

According to Table 3-4, there were 35 records that listed using Route 8 but did not list Waikīkī as a destination. There were also 29 records that listed using Route 8 to get to their destination at Ala Moana but Waikīkī was not the origin. Again, this is impossible since Route 8 is a shuttle between Ala Moana and Waikīkī only.

For the 200 records where Ala Moana was listed as the origin, 71 may have transferred at Ala Moana to get to their final destination. This was determined by manually verifying the stated destination, the bus-on variable which is obtained from the global positioning system (GPS) unit, the route they were surveyed on, the various buses they listed, the mode they took to get to the first bus, the mode they took to get to their final destination, the number of blocks walked to first bus, the number of blocks walked to final destination, and the trip purpose. This same process could not be performed for the 192 records where Ala Moana was listed as the destination since the bus stop off (bus-off) (the location where a rider gets off the bus) variable is imputed. Many of these records had to be deleted since they could not be verified correctly.

The 513 originally suspect records were manually verified as described in this section. If a record could not logically explain the route chosen based on the origin, destination, and possible routes to AMC, it was removed from the survey sample set. In total, 294 of the suspect records to/from AMC were removed from the survey set. The other 219 records were cleaned properly and left in the survey dataset. The survey was re-expanded based on the newly cleaned dataset and mode choice was recalibrated. The process of cleaning/deleting suspect records from the OBS only decreased the amount of trips to AMC by 1 percent but did result in a more reliable OBS dataset. The two survey totals are still different, but the calibration and validation section of the report shows the final decision regarding model adjustments of trips to AMC.

3.1.2 Transit On Board Survey Analysis

A new OBS was done between December 2005 and January 2006. Data was collected using an innovative methodology that included the distribution of questionnaires to boarding passengers while simultaneously recording the boarding and alighting counts using GPS-enhanced palm devices. The palm devices with GPS recorded the location and time (arrival and departure) at each bus stop. By entering questionnaire numbers into the units prior to arrival at a bus stop, this process also tied a sequence of questionnaires directly to a bus stop. This process allowed for expanding the data by route, time of day (TOD), direction, and bus stop location. The 1992 survey was only expanded by route, TOD, and direction. By adding bus stop location to the expansion process, the data is more accurately represented since certain bus stop locations along a route had higher response rates than other locations, especially longer trips as shown in Figure 3-1.

The O‘ahuMPO model has four transit sub-modes—walk-to-local, walk-to-express, PNR, and KNR—and two time periods—peak and off-peak. Thus, eight trip tables were constructed for the four sub-modes and two time periods and were assigned to their respective networks. The assignments were then combined to produce a daily transit assignment.

The transit trip tables were assigned using the same path building parameters used for skimming (Table 3-5). Table 3-6 shows the bus speed factors used in the model. The resulting transit boardings by class of service are shown in Table 3-7. Table 3-8 shows the resulting transit boardings by route for the observed 2005 boardings (expanded survey) and the 2005 assigned OBS boardings using the new (route, TOD, direction, bus-on location) expansion factor. The 91 percent R^2 in Figure 3-2 shows that the goodness of fit is excellent and that the transfer penalty and path parameters reflect what is being observed.

Table 3-5: Current Model Path Building Parameters

Parameter	Result
Walk to Local/Limited Stop Bus	
Walk speed	3 mph
Maximum walk distance	2.5 miles
Initial wait time factor	2
In-vehicle time factor for local bus	1
In-vehicle time factor for limited stop	0.9
Transfer wait time factor	2
Transfer wait time penalty	4 minutes
Maximum perceived path time	300 minutes
Walk to Express Bus	
Walk speed	3 mph
Maximum walk distance	2.5 miles
Initial wait time factor	2
In-vehicle time factor	1.2
Bonus in-vehicle time factor for express bus	1
Transfer wait time factor	2
Transfer wait time penalty	4 minutes
Maximum perceived path time	300 minutes
Drive Access/Egress to Bus	
Walk speed	3 mph
Maximum drive time	15 minutes
Maximum walk distance	2.5 miles
Initial wait time factor	2
In-vehicle time factor	1
Transfer wait time factor	2
Transfer wait time penalty	4 minutes
Maximum perceived path time	300 minutes

Note: The kiss-and-ride parameters were the same as the walk-to-local bus mode.

Table 3-6: Bus Speed Factors

Functional Class	Peak Factor	Off Peak Factor
Freeways / Expressways	1.0	1.0
Ramps	1.0	1.0
Arterial I	1.54	1.65
Arterial II	1.24	1.53
Arterial III	1.95	0.83
Collector I	1.22	1.50
Collector II	1.81	1.18
Local	0.83	1.41

Table 3-7: Transit Boardings by Class of Service

Class of Service	2005 Observed	2005 Year (OBS Assignment) New Expansion Factor (Route, TOD, Direction, Bus-on)	Percent Difference (New Expansion Factor Assignment / Observed)
Limited stop	29,184	29,891	1.02
Urban trunk	112,111	115,464	1.03
Suburban trunk	62,159	57,183	0.92
Urban feeder	12,943	9,939	0.77
Suburban feeder	2,312	2,491	1.08
Community circulator	9,573	7,037	0.74
Peak express	8,273	8,059	0.97
Total	***236,555***	***230,062***	***0.97***

Table 3-8: Transit Boardings by Route Number

Class of Service	Route Number	2005 Observed	2005 Year (OBS Assignment) *	Percent Difference (New Expansion Factor Assignment / Observed)
Limited Stop Routes				
1	A	15,429	19,835	1.29
1	B	7,443	4,237	0.57
1	C	6,312	5,818	0.92
Subtotal		*29,184*	*29,891*	*1.02*
Urban Trunk Routes				
2	1	21,096	25,587	1.21
2	2	19,863	19,808	1.00
2	3	12,435	14,038	1.13
2	4	9,827	7,863	0.80
2	5	1,557	1,358	0.87
2	6	6,635	6,405	0.97
2	8	9,254	3,635	0.39
2	9	10,121	6,697	0.66
2	13	13,423	17,341	1.29
2	19	5,357	5,734	1.07
2	20	2,543	6,996	2.75
Subtotal		*112,111*	*115,464*	*1.03*
Suburban Trunk Routes				
3	11	1,382	452	0.33
3	22	2,513	421	0.17
3	40	8,083	10,212	1.26
3	41	2,369	1,073	0.45
3	42	10,824	8,836	0.82
3	43	2,806	2,135	0.76
3	52	4,826	3,976	0.82
3	53	3,701	2,702	0.73
3	54	4,542	1,942	0.43
3	55	3,835	4,268	1.11
3	56	3,198	3,496	1.09
3	57	4,345	4,975	1.15
3	58	2,650	4,336	1.64
3	62	5,099	5,860	1.15
3	65	1,987	2,500	1.26
Subtotal		*62,159*	*57,183*	0.92

Table 3-8: Transit Boardings by Route Number (continued)

Class of Service	Route Number	2005 Observed	2005 Year (OBS Assignment) *	Percent Difference (New Expansion Factor Assignment / Observed)
Urban Feeder				
4	7	3,929	4,296	1.09
4	10	692	401	0.58
4	14	1,823	2,528	1.39
4	15	928	426	0.46
4	16		109	
4	17	1,482	375	0.25
4	18	735	202	0.27
4	21	65	0	0.01
4	31	642	330	0.51
4	32	2,647	1,271	0.48
Subtotal		*12,943*	*9,939*	*0.77*
Suburban Feeder				
5	70	253	533	2.10
5	71		190	
5	72	494	342	0.69
5	73	870	857	0.98
5	74		62	
5	76	469	400	0.85
5	77	225	108	0.48
Subtotal		*2,312*	*2,491*	*1.08*
Com Circulator				
6	401	332	344	1.04
6	402	195	568	2.91
6	403	526	119	0.23
6	411	805	345	0.43
6	412	456	480	1.05
6	413	190	168	0.89
6	414		82	
6	415		21	
6	421	484	138	0.29
6	431	521	17	0.03
6	432	3,145	601	0.19
6	433	1,043	1,233	1.18
6	434	1,876	2,919	1.56
6	503		—	
Subtotal		*9,573*	*7,037*	*0.74*

Table 3-8: Transit Boardings By Route Number (continued)

Class of Service	Route Number	2005 Observed	2005 Year (OBS Assignment) *	Percent Difference (New Expansion Factor Assignment / Observed)
Peak Express				
7	80	317	363	1.14
7	81	1,312	920	0.70
7	82		37	
7	83	593	1,132	1.91
7	84	485	502	1.04
7	85	460	46	0.10
7	86		19	
7	88	336	267	0.80
7	89		66	
7	90	114	214	1.88
7	91	975	747	0.77
7	92	240	182	0.76
7	93	1,153	763	0.66
7	95		—	
7	96	156	129	0.83
7	97	408	575	1.41
7	98	210	20	0.09
7	101	405	630	1.56
7	102	180	156	0.87
7	103		143	
7	201	543	798	1.47
7	202	258	248	0.96
7	203	129	101	0.78
Subtotal		*8,273*	*8,059*	0.97
Grand Total		***236,555***	***230,062***	***0.97***

*New expansion factor (route, TOD, direction, bus-on)

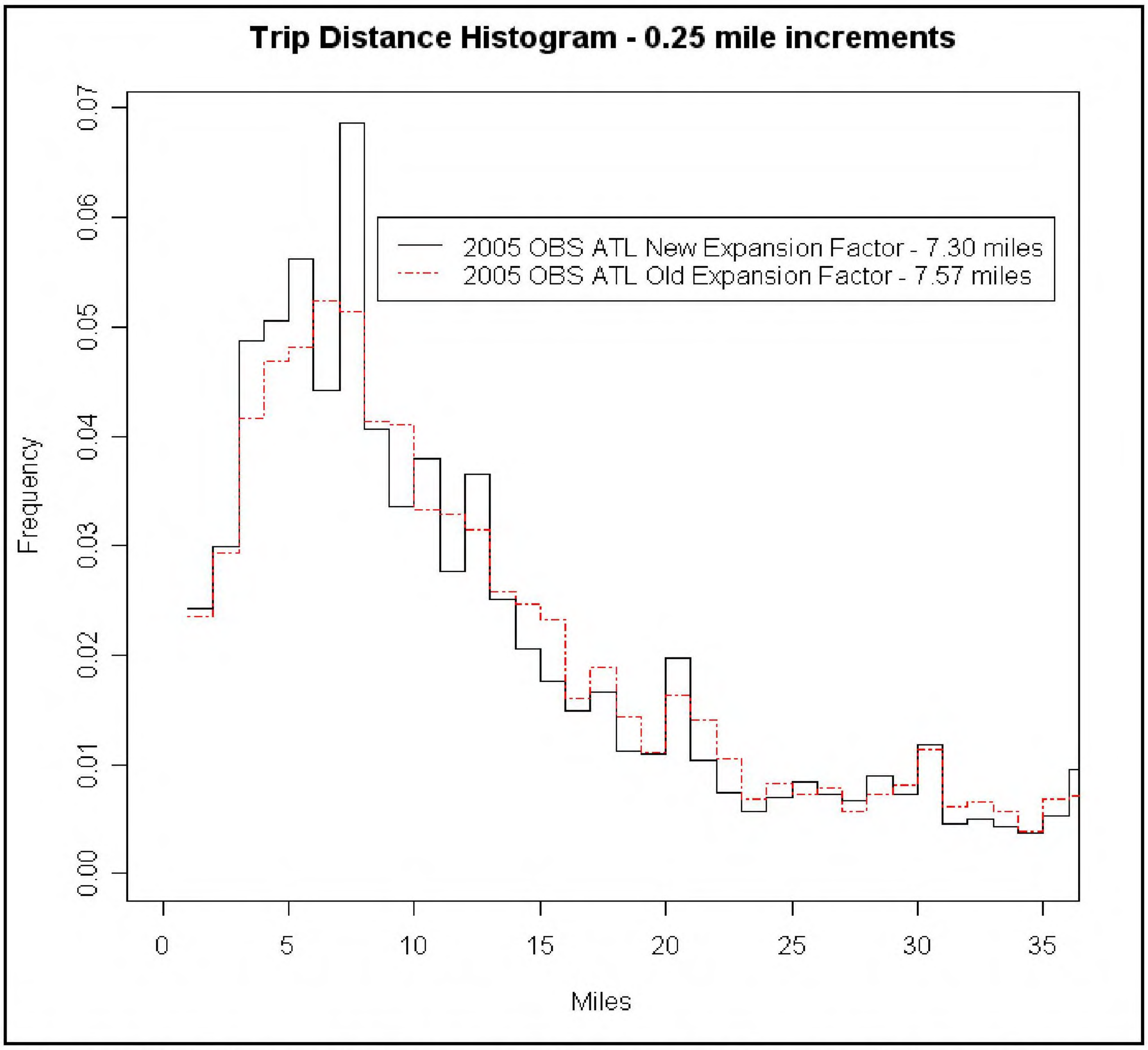

Figure 3-1: Trip Length Frequency Histogram Difference between New and Old Expansion Factor

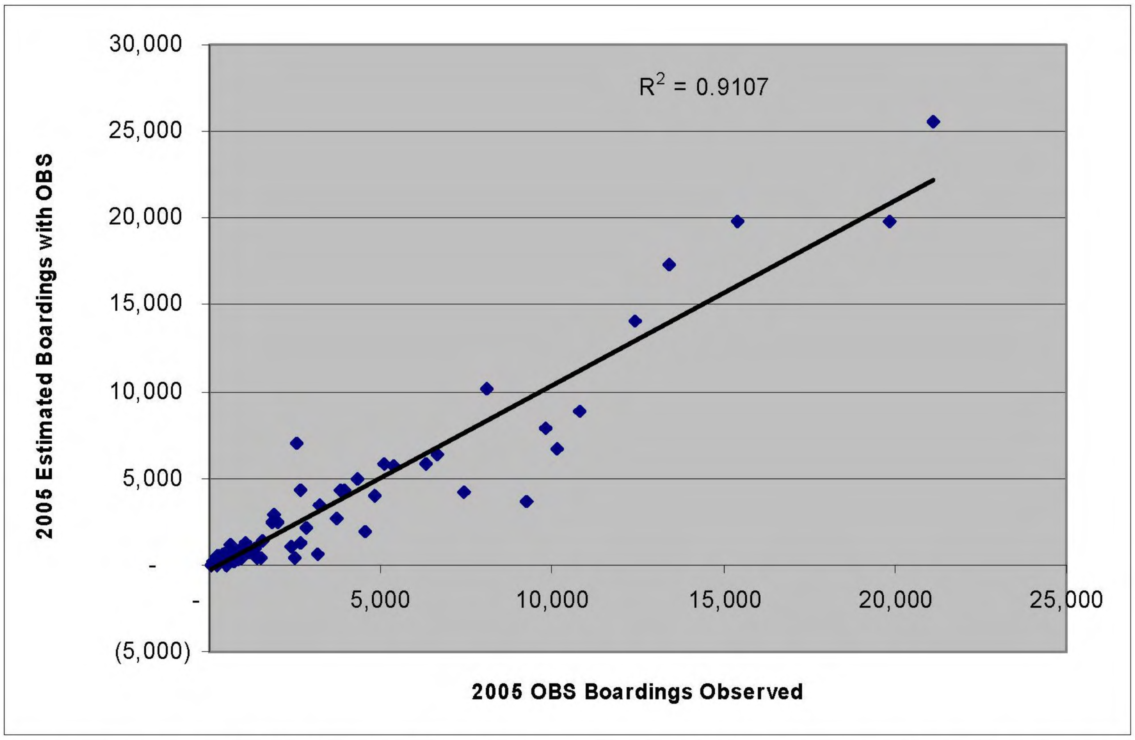

Figure 3-2: 2005 Observed Boardings and 2005 Estimated Boardings with On-board Survey Data for each Route

Some routes that had notable differences in assignment boardings versus observed boardings were examined further. The routes analyzed were Routes A, B, 1, 8, 9, 13, 20, 22, 40, 54, and 432. An assignment of the OBS for each one of these surveyed routes was done to determine why there were differences between the observed and the estimated boardings. See Table 3-9 for the results.

- Out of the 11,433 linked trips surveyed on Route A, only 4,980 boardings were assigned on the Route A. Some of the other routes that these trips boarded were Routes 1, 2, 3, 6, 13, 40, 42, and 62. Most of these routes are competing routes with Route A.
- Out of the 5,344 linked trips surveyed on Route B, only 745 boardings were assigned on the Route B. Some of the other routes that these trips boarded were Routes A, 1, 2, 7, and 13. Most of these routes are competing routes with Route B.
- Out of the 15,918 linked trips surveyed on Route 1, only 11,700 boardings were assigned on the Route 1. Some of the other routes that these trips boarded were Routes A, 2, 3, 4, 6, 9, 13, 14, 58, and 73. Most of these routes are competing routes with Route 1.
- Out of the 8,165 linked trips surveyed on Route 8, only 2,369 boardings were assigned on the Route 8. Some of the other routes that these trips boarded were Routes 2, 4, 13, 19, 20, 42, 58, and 65. Most of these routes are competing routes with Route 8.

- Out of the 7,603 linked trips surveyed on Route 9, only 2,895 boardings were assigned on the Route 9. Some of the other routes that these trips boarded were Routes A, 1, 2, 3, 7, 13, 19, 20, 40, 42, 58, and 62. Most of these routes are competing routes with Route 9.
- Out of the 9,885 linked trips surveyed on Route 13, only 4,780 boardings were assigned on the Route 13. Some of the other routes that these trips boarded were Routes A, B, 1, 2, 3, 4, 19, and 20. Most of these routes are competing routes with Route 13.
- Out of the 2,204 linked trips surveyed on Route 20, only 602 boardings were assigned on the Route 20. Some of the other routes that these trips boarded were Routes A, 2, 13, 19, 40, and 42. Most of these routes are competing routes with Route 20.
- Out of the 2,212 linked trips surveyed on Route 22, only 98 boardings were assigned on the Route 22. Some of the other routes that these trips boarded were Routes 1, 2, 3, 13, 20, 57, and 58. Most of these routes are competing routes with Route 22.
- Out of the 6,003 linked trips surveyed on Route 40, only 2,882 boardings were assigned on the Route 40. Some of the other routes that these trips boarded were Routes A, C, 1, 2, 19, 20, 42, and 62. Most of these routes are competing routes with Route 40.
- Out of the 3,434 linked trips surveyed on Route 54, only 796 boardings were assigned on the Route 54. Some of the other routes that these trips boarded were Routes A, 1, 2, 3, 53, and 73. Most of these routes are competing routes with Route 54 while others are feeders to main trunk lines.
- Out of the 2,115 linked trips surveyed on Route 432, only 445 boardings were assigned on the Route 432. Some of the other routes that these trips boarded were Routes A, 40, 43, 81, and 434. Most of these routes are competing routes with Route 432 while others are feeders to main trunk lines.

Table 3-9: On-board Survey Assignment by Route Surveyed On

Route	Route A	Route B	Route 1	Route 8	Route 9	Route 13	Route 20	Route 22	Route 40	Route 54	Route 432
Limited Stop Routes											
A	4,980	517	812	50	521	485	718	18	582	1,439	474
B	70	745	205	23	5	204	6	—	—	38	—
C	144	50	5	55	61	34	—	—	1,410	11	—
Subtotal	*5,194*	*1,311*	*1,023*	*128*	*587*	*723*	*724*	*18*	*1,992*	*1,489*	*474*
Urban Trunk Routes											
1	1,240	496	11,700	3	1,730	1,046	63	631	272	105	—
2	520	2,209	1,090	465	427	2,370	111	377	193	114	4
3	439	120	724	53	1,199	565	34	177	58	101	20
4	282	190	528	211	22	430	37	47	65	1	—
5	7	27	39	47	20	11	—	8	8	8	—
6	978	127	492	2	105	115	51	12	24	31	—
8	14	53	4	2,369	33	68	35	87	19	94	—
9	185	62	525	27	2,895	17	51	31	70	26	—
13	457	851	917	475	448	4,780	118	352	206	69	4
19	45	120	244	942	435	185	554	76	165	44	—
20	66	174	55	1,495	412	257	602	116	182	81	—
Subtotal	*4,233*	*4,430*	*16,319*	*6,089*	*7,726*	*9,844*	*1,655*	*1,914*	*1,261*	*675*	*29*

Table 3-9: On-board Survey Assignment by Route Surveyed On (continued)

Route	Route A	Route B	Route 1	Route 8	Route 9	Route 13	Route 20	Route 22	Route 40	Route 54	Route 432
Suburban Trunk Routes											
11	42	—	2	—	5	4	—	—	31	53	—
22	3	1	91	17	24	2	—	98	—	—	—
40	1,490	39	67	—	265	83	158	—	2,882	69	318
41	5	8	—	—	—	—	—	—	27	—	3
42	1,339	33	102	915	241	85	157	37	448	48	201
43	286	23	64	—	86	94	18	—	35	10	389
52	146	64	176	71	64	41	5	18	39	21	—
53	224	38	113	—	64	178	10	—	68	397	—
54	128	27	145	19	54	90	10	—	28	796	—
55	47	30	9	15	83	112	6	4	30	3	—
56	45	35	28	7	59	84	18	4	48	11	—
57	26	53	66	11	84	91	34	199	76	23	—
58	9	22	459	869	248	44	50	996	1	1	—
62	458	34	55	43	251	62	92	—	272	82	11
65	19	12	17	112	62	54	14	2	1	28	—
Subtotal	*4,267*	*417*	*1,393*	*2,080*	*1,592*	*1,025*	*571*	*1,358*	*3,987*	*1,542*	*921*
Urban Feeder											
7	147	335	191	—	306	23	19	—	16	9	—
10	92	—	70	—	—	—	0	—	—	—	—
14	-	8	674	18	60	1	—	21	6	9	—
15	—	—	2	—	14	66	—	—	—	4	—
16	—	—	—	—	18	—	13	—	—	2	—
17		6	22	—	2	4	6	—	—	1	—
18	1	3	11	—	1	2	3	—	—	0	—
21	—	—	—	—	—	—	—	—	—	—	—
31	5	10	17	—	5	—	—	—	17	0	—
32	26	16	—	23	6	20	—	—	25	3	45
Subtotal	*271*	*378*	*988*	*41*	*411*	*116*	*42*	*21*	*64*	*30*	*45*

Table 3-9: On-Board Survey Assignment by Route Surveyed On (continued)

Route	Route A	Route B	Route 1	Route 8	Route 9	Route 13	Route 20	Route 22	Route 40	Route 54	Route 432
Suburban Feeder											
70	—	2	—	—	—	—	—	—	—	—	—
71	6	—	—	—	—	—	—	—	—	160	—
72	—	—	—	25	—	—	—	—	—	—	—
73	9	9	347	—	—	—	—	—	43	208	—
74	—	—	—	—	—	—	—	—	—	5	—
76	—	—	—	—	—	—	—	—	—	—	—
77	—	—	—	—	—	—	—	0	—	—	—
Subtotal	*14*	*11*	*347*	*25*	—	—	—	*0*	*43*	*373*	—
Community Circulator											
401	8	—	—	—	—	—	—	—	42	—	—
402	—	6	—	—	—	9	—	—	247	—	—
403	—	—	—	—	—	14	—	—	57	—	—
411	8	—	—	—	—	—	—	—	52	10	—
412	18	—	5	—	—	—	—	—	107	—	—
413	—	—	—	—	—	—	—	—	66	—	—
414	4	—	—	—	—	—	—	—	9	2	—
415	—	—	—	—	—	—	—	—	12	—	—
421	—	—	—	—	—	—	—	—	—	—	—
431	—	—	—	—	—	—	—	—	3	—	—
432	98	—	—	—	—	—	—	—	6	—	445
433	200	—	36	—	—	31	45	—	20	—	2
434	814	5	—	—	—	31	13	—	124	2	415
503	—	—	—	—	—	—	—	—	—	—	—
Subtotal	*1,150*	*11*	*41*	—	—	*85*	*59*	—	*744*	*14*	*862*

Table 3-9: On-board Survey Assignment by Route Surveyed On (continued)

Route	Route A	Route B	Route 1	Route 8	Route 9	Route 13	Route 20	Route 22	Route 40	Route 54	Route 432
Peak Express											
80	8	24	—	—	0	—	—	—	8	—	—
81	52	47	7	—	0	—	—	—	—	—	56
82	—	—	—	—	22	—	—	—	—	—	—
83	35	0	—	—	20	—	—	—	18	38	—
84	104	0	—	—	5	—	—	—	—	—	—
85	—	—	—	—	—	—	—	—	—	—	—
86	—	—	—	—	—	—	—	—	—	—	—
88	—	—	—	—	15	—	—	—	—	1	—
89	—	—	—	—	22	—	—	10	—	—	—
90	24	7	—	—	—	—	—	—	—	73	—
91	24	13	28	—	2	5	—	—	54	4	—
92	24	0	—	—	—	1	—	—	—	—	—
93	—	8	40	—	6	69	54	—	1	—	—
95	—	—	—	—	—	—	—	—	—	—	—
96	—	7	—	—	—	9	—	—	—	—	—
97	62	—	—	—	—	—	—	—	—	1	—
98	—	—	—	—	—	—	—	—	—	—	—
101	24	3	28	—	2	—	—	—	1	—	—
102	—	0	—	—	—	13	—	—	1	—	—
103	—	—	5	—	—	—	—	—	3	—	—
201	—	20	12	—	—	16	2	—	—	4	17
202	—	15	—	—	—	—	1	—	—	—	—
203	—	—	—	—	—	—	—	—	—	—	—
Subtotal	*357*	*145*	*119*	—	*94*	*114*	*58*	*10*	*85*	*122*	*72*
Grand Total	***15,486***	***6,704***	***20,231***	***8,363***	***10,410***	***11,906***	***3,109***	***3,323***	***8,176***	***4,244***	***2,403***
Total Linked Trips	***11,433***	***5,344***	***15,918***	***8,165***	***7,603***	***9,885***	***2,204***	***2,212***	***6,003***	***3,434***	***2,115***

The on-board assignment showed that the 230,062 assigned boardings matched within 97 percent of the observed expanded boardings. The 91 percent R^2 between the assigned boardings and the observed boardings shows an excellent fit and that the transfer penalty and path parameters are reflecting the observed data. Individual routes were overestimated when compared to the observed, but this was due to competing routes along corridors. The overall corridor ridership accurately reflected the observed data, and the assignment did not need to be adjusted.

3.1.3 Auto-ownership versus CTPP Comparison

The Oʻahu MPO auto-ownership model was compared to census data to determine degree of model fit in the base year. The analysis revealed that the model was under-estimating 0-auto households, and over-estimating 3+ auto households, compared to 2000 census data.[1] Upon further investigation, it was determined that estimated versus observed households by income and workers per household, which are input to the auto-ownership model, were not matching census data and may have been adversely affecting the auto-ownership model results. Since auto ownership is an important market segmentation variable in the models used to predict mode choice for Oʻahu, the model was re-calibrated as follows:

- 2000 census data was obtained for Oʻahu at a tract level. The data obtained included a three-way tabulation of households by household size, number of workers, and household income. The one-way tabulation of households by auto ownership was also obtained.
- The census tabulations were disaggregated to a transportation analysis zone (TAZ) level using geographic information system (GIS) procedures.
- The disaggregated 3-way tabulation of households was scaled to input 2005 households using a 2-dimensional matrix zonal balancing procedure (where zonal households were row totals and regional totals by each cross-classification of household size, household income, and workers per household were column totals).
- The scaled 3-way tabulation was input to the auto-ownership program (in the ZDISTRIB file) and the auto-ownership program was re-run with the revised distribution.
- Upon further analysis, it was determined that the auto-ownership alternative-specific constants had to be recalibrated to match regional households by auto ownership from census.
- The final calibrated results were plotted and investigated to determine the extent of possible geographic biases. The plots indicate that the model somewhat under-estimates 0-auto households in the central business district (CBD) district and Districts 4 (Waikīkī) and 7 (Kalihi-Iwilei). To correct this

[1] It should be noted that 2000 Census data was not available when the model was initially developed; instead, the model was calibrated to household survey data, indicating that the household survey may have been biased towards an under-representation of 0-auto households and therefore captive transit riders.

under-estimate, district-level constants would need to be introduced in the auto-ownership model. It was determined that the recalibrated model represents a significant improvement over the original model and that district-level constants would not be added at this time.

Table 3-10 through Table 3-13 show households by income, size, workers, and auto ownership, respectively, for 2000 census, 2005 old (model before recalibration), and 2005 new (model after recalibration).

Table 3-13 shows district-level auto-ownership results compared to census. Figure 3-3 through Figure 3-6 show zonal level comparisons of average vehicles owned and 0-auto households to Census for the old model (Figure 3-3 and Figure 3-4) and the recalibrated model (Figure 3-5 and Figure 3-6).

Table 3-10: Households by Income

	2000 Census		2005 Old		2005 New	
	Households	Percent	Households	Percent	Households	Percent
0-20	45,851	16%	57,282	19%	48,996	16%
20-40	47,048	16%	88,944	29%	50,082	17%
40-75	103,757	36%	105,554	35%	108,986	36%
75+	89,794	31%	50,905	17%	94,696	31%
Total	***286,450***	***100%***	***302,685***	***100%***	***302,760***	***100%***

Table 3-11: Households by Household Size

	2000 Census		2005 Old		2005 New	
	Households	Percent	Households	Percent	Households	Percent
1	61,901	22%	61,009	20%	67,548	22%
2	82,454	29%	90,137	30%	87,024	29%
3	51,621	18%	59,381	20%	53,536	18%
4	43,742	15%	49,375	16%	46,687	15%
5	47,013	16%	42,783	14%	47,965	16%
Total	***286,731***	***100%***	***302,685***	***100%***	***302,760***	***100%***

Table 3-12: Households by Workers per Household

	2000 Census		2005 Old		2005 New	
	Households	Percent	Households	Percent	Households	Percent
0	64,480	22%	50,986	17%	69,756	23%
1	100,730	35%	112,281	37%	103,917	34%
2	121,525	42%	139,418	46%	129,087	43%
Total	***286,735***	***100%***	***302,685***	***100%***	***302,760***	***100%***

Table 3-13: Households by Vehicles Owned

	2000 Census		2005 Old		2005 New	
	Households	Percent	Households	Percent	Households	Percent
0	36,478	13%	31,113	10%	38,907	13%
1	107,161	37%	109,029	36%	113,525	37%
2	98,379	34%	93,285	31%	103,496	34%
3	44,713	16%	69,258	23%	46,958	16%
Total	***286,731***	***100%***	***302,685***	***100%***	***302,886***	***100%***
Average	*1.53*		*1.66*		*1.53*	

Table 3-14: Estimated versus Census Percent Households by Vehicles Owned and District

District	Observed				Estimated			
	0 Veh	1 Veh	2 Veh	3+ Veh	0 Veh	1 Veh	2 Veh	3+ Veh
1	42%	46%	10%	1%	34%	46%	17%	3%
2	29%	54%	15%	2%	27%	49%	20%	5%
3	30%	53%	15%	2%	25%	48%	21%	5%
4	37%	52%	9%	2%	28%	48%	20%	4%
5	10%	40%	35%	15%	12%	38%	34%	16%
6	19%	37%	28%	16%	15%	37%	33%	16%
7	37%	40%	15%	7%	21%	40%	28%	12%
8	4%	44%	46%	6%	6%	38%	40%	16%
9	5%	42%	40%	13%	8%	38%	38%	16%
10	6%	34%	39%	22%	9%	35%	38%	19%
11	5%	29%	44%	22%	7%	32%	40%	21%
12	3%	28%	50%	18%	9%	31%	39%	20%
13	3%	32%	43%	22%	11%	37%	36%	16%
14	9%	30%	39%	22%	9%	32%	39%	21%
15	4%	36%	45%	15%	6%	35%	40%	19%
16	4%	27%	48%	21%	6%	31%	41%	21%
17	13%	42%	31%	14%	13%	39%	34%	15%
18	4%	25%	49%	22%	7%	31%	41%	21%
19	5%	28%	44%	24%	8%	32%	40%	20%
20	6%	30%	45%	20%	9%	35%	38%	18%
21	10%	42%	33%	15%	12%	37%	35%	16%
22	7%	36%	36%	21%	11%	39%	35%	15%
23	11%	35%	34%	20%	14%	36%	34%	16%
24	15%	50%	27%	8%	15%	44%	30%	11%
25	27%	41%	25%	8%	21%	41%	28%	10%
26	25%	59%	14%	2%	47%	49%	4%	0%
Total	***13%***	***37%***	***34%***	***16%***	***13%***	***37%***	***34%***	***16%***

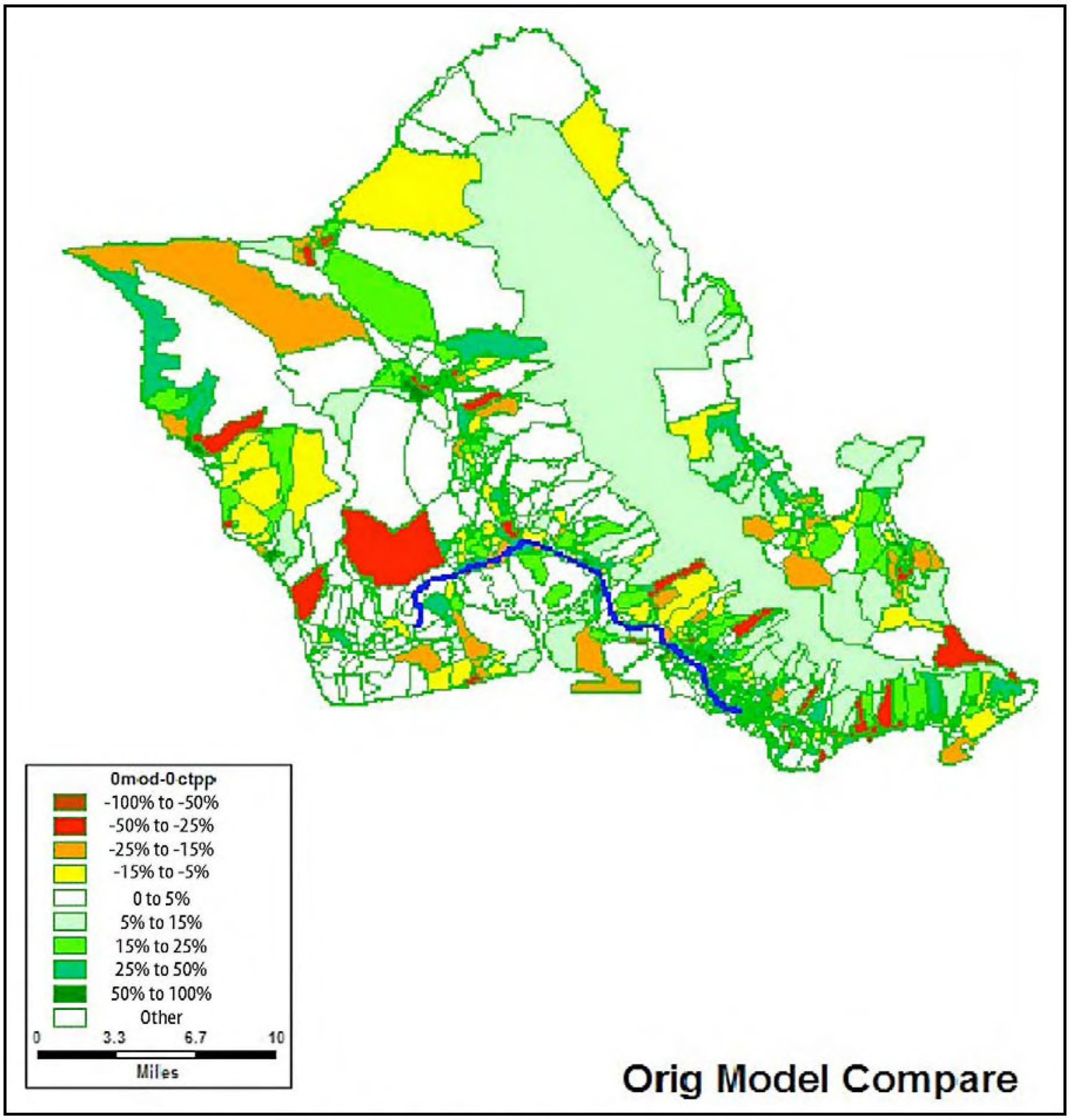

Figure 3-3: Original Auto-ownership Model versus Census—Comparison of Average Vehicles Owned

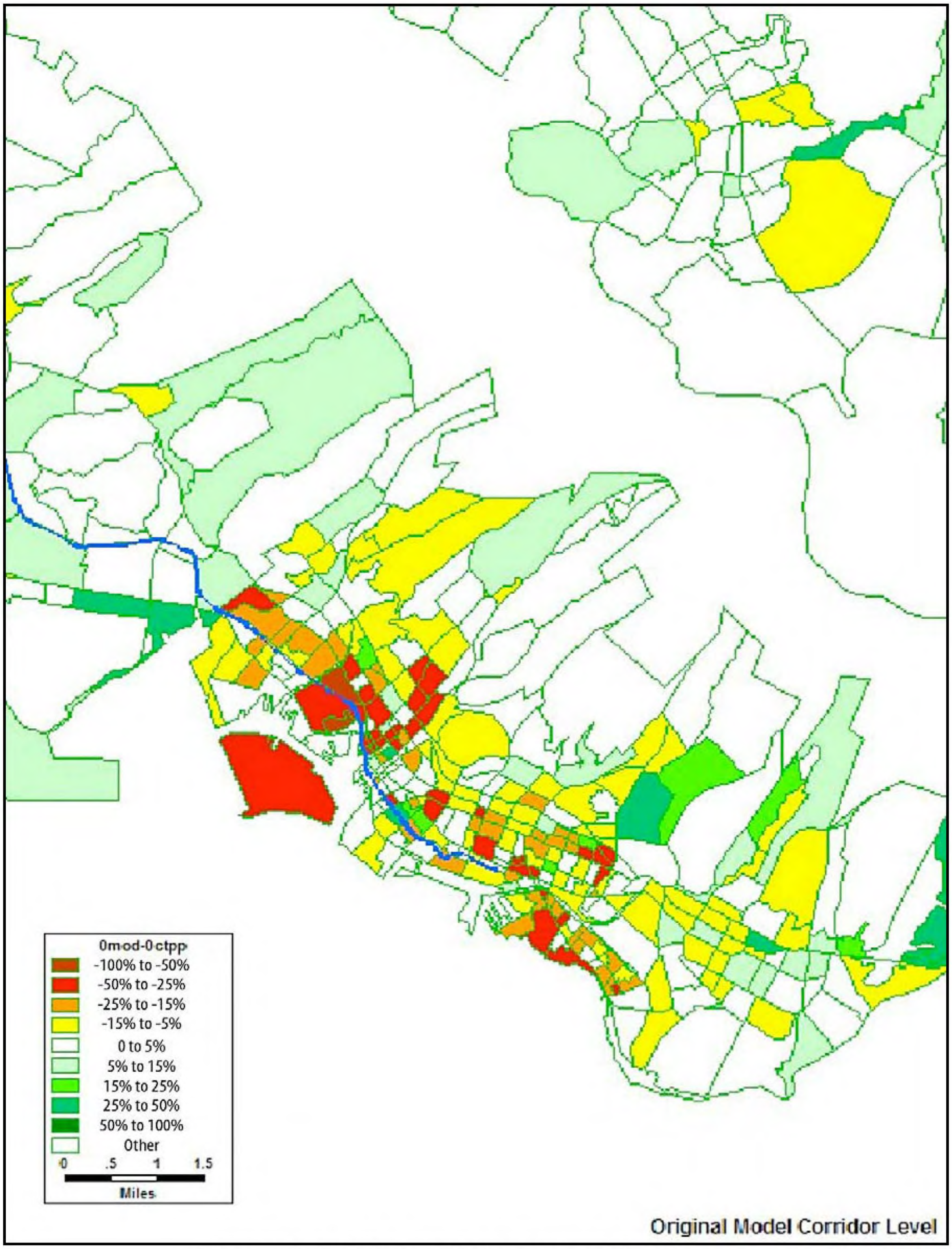

Figure 3-4: Original Auto-ownership Model versus Census—Comparison of 0-Vehicle Households in Project Corridor

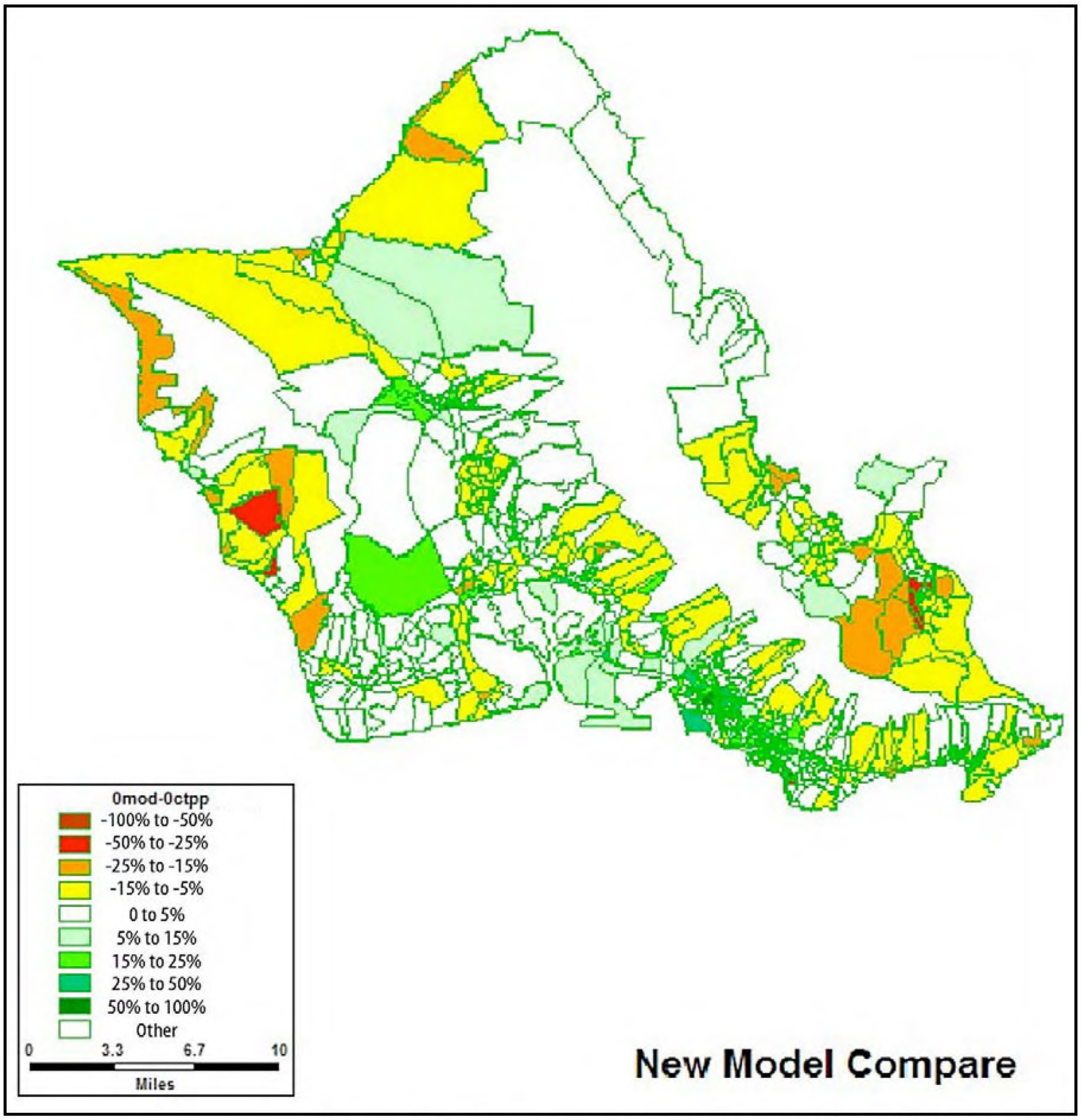

Figure 3-5: Recalibrated Auto-ownership Model versus Census—Comparison of Average Vehicles Owned

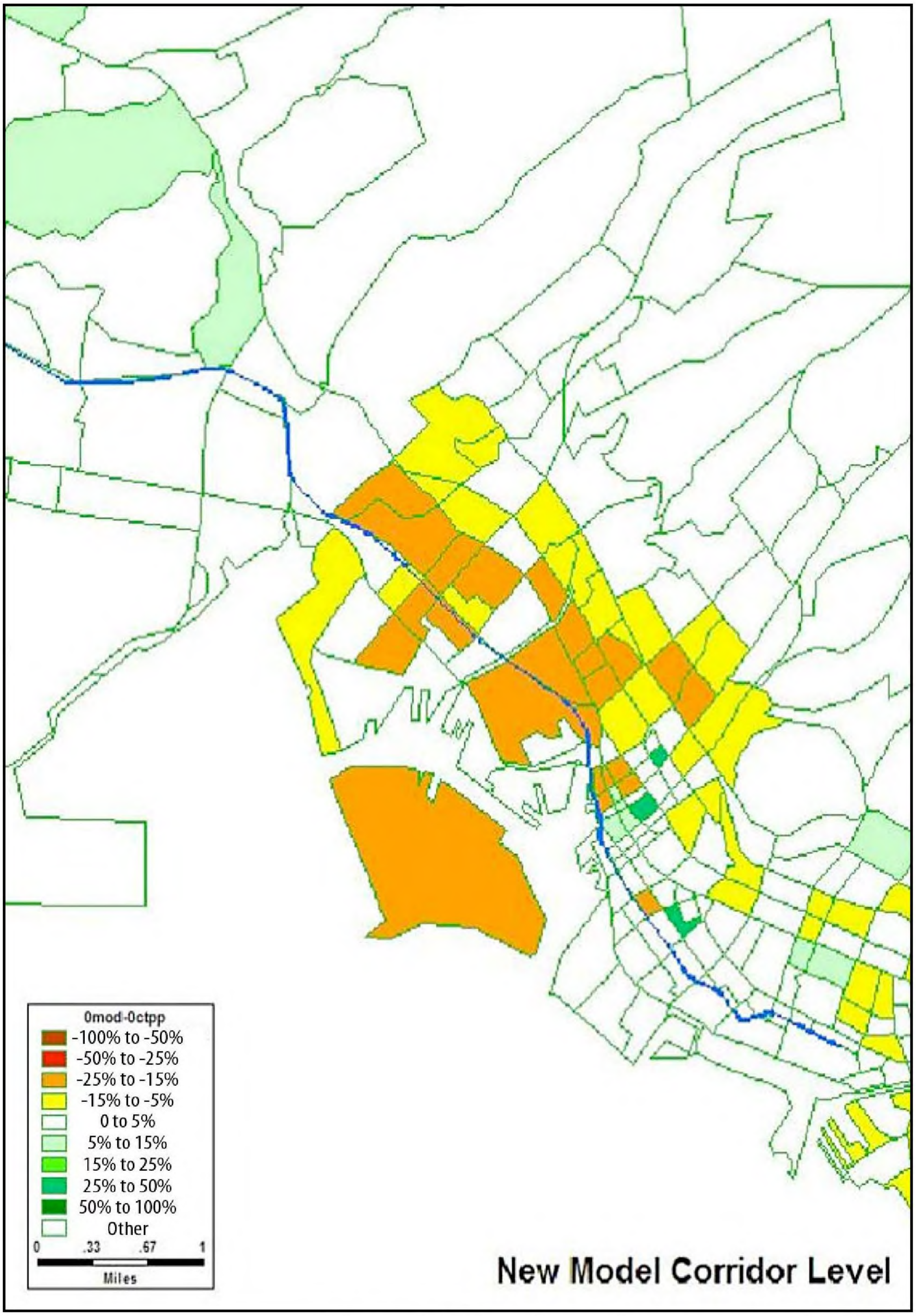

Figure 3-6: Recalibrated Auto-ownership Model versus Census—Comparison of 0-Vehicle Households in Project Corridor

Based on these findings, the auto-ownership model was recalibrated and included new alternative-specific constants and verification of the trip distribution of the model.

3.1.4 Analysis of Highway Travel Time by Traffic Group

There was concern about the effect that the model speeds were having on the forecasting results. Speed and travel time data were acquired for eight corridors in the Oʻahu area.

The congested speeds from the travel demand model were compared with the actual travel times on specific paths in Oʻahu.

The travel time run data focused mostly on the H-1 and H-2 Freeways and the zipper/high-occupancy vehicle (HOV) lanes. There was limited data for a few principal arterials, minor arterials, and a few collectors.

Table 3-15 briefly describes the routes that were followed for the travel time runs.

Table 3-15: Original Auto-ownership Model versus Census—Comparison of 0-Vehicle Households in Project Corridor

Route Number	Major Routes in Run	Description of Route
H-1 #1	H-1, Nimitz Highway	Farrington Highway (from Mākaha) to H-1 Eastbound to Nimitz Highway
H-1 #1 Zipper	H-1, Nimitz Highway	Farrington Highway (from Mākaha) to H-1 Eastbound to Nimitz Highway (in zipper lane where applicable)
H-1 #2	H-1, Fort Barrette Road	Fort Barrette Road (from Kapolei) to H-1 to Paiwa Street (in Waipahu)
H-1 #3	H-1, Fort Weaver Road	Fort Weaver Road (from ʻEwa beach) to H-1 to Paiwa Street
H-1 #4	Farrington Highway, H-1, Moanalua Road	Farrington Highway (from Leokū) to Moanalua Road to Waimano Home Road
H-1 #5	H-2, H-201, H-1, and Pali Highway	H-2 (at Mililani) to H-1 to H-201 to Pali Highway (into Downtown)
H-1 #5 HOV	H-2, H-201, H-1, and Pali Highway	H-2 (at Mililani) to H-1 to H-201 to Pali Highway (into Downtown) (uses HOV lanes where possible)

8th corridor was not used because the data was not complete.

Each study route had several travel time runs that were generally performed from 5 a.m. to 9 a.m. Since the AM peak of the model is 6:30–8:30 a.m., only the travel times in this same time period were used for comparison purposes (note: H-1 #5 HOV and H-1 #5 runs required that all times be averaged to get a good sample). Each segment of the route in the travel-time study was matched with a corresponding link on the travel demand model network. Since some of the links were the same between routes, each travel time study link was given its own segment ID so that each route could be compared individually with the model links.

Portions of the travel-time segments were discarded because the data was out of range (speeds over 150 miles per hour [mph]).

Overall as a general conclusion, the freeway speeds from the travel demand model are higher than the actual observed travel times (Table 3-16), although speeds on individual segments are lower in some locations.

It is important to note some areas of specific interest:

- H-1 from the Airport to Nimitz Highway into Downtown is consistently 12 to 15 mph faster in the model (in all routes that use these segments)
- H-1 from H-2 (Waipahu Exit) to H-201 is consistently lower in the model by an average of 20 mph
- Zipper lanes along H-1 are slower (12 to 20 mph) in the model
- H-1 from Farrington (Kapolei area) times are slightly slow in the model while the zipper lane in the same corridor is faster than the observed travel time
- Farrington Highway is faster in the model by an average of 23 mph

Table 3-16: Model versus Observed Travel Times

Route Number	Model Travel Time (minutes)	Observed Travel Time (minutes)	% Difference
H-1 #1	67.25	89.0	-24.4
H-1 #1 Zipper	68.86	76.0	-9.39
H-1 #2	17.28	16.32	5.8
H-1 #3	21.62	21.33	1.4
H-1 #4	24.40	33.65	-27.5
H-1 #5	49.5	60.1	-17.6
H-1 #5 HOV	43.38	70.4*	-38.1

*This observed travel time is questionable because there is only one run in the AM peak.

The following tables show the compared results for specific segments of each run. There is also a map of the route color coded by the difference between the observed and modeled data. The difference is model speed minus the runtime column from the speed study. A negative value represents higher speeds in the model versus those observed.

Table 3-17: Route H-1 #1—Farrington Highway (from Mākaha) to H-1 Eastbound to Nimitz Highway

ID	Model Congested Speed	Section Name	Average Speed from Travel Time Study	run1 diff
3754	15.2	Waiawa Road Underpass and H-1	24.74	-9.54
7443	14.5	Lehua Avenue (Pearl City Viaduct) and H-1	46.98	-32.48
3960	20.1	Kaahumanu Overpass and H-1	30.25	-10.15
7445	20.1	Kaonohi Overpass and H-1	31.75	-11.65
7449	16.8	Kaimakani Overpass and H-1	53.71	-36.91
3632	48.1	Salt Lake Boulevard and H-1	13.38	NA
4441	45.2	Radford Drive and H-1	71.62	-26.42
8328	59.7	Airport Exit (eastbound) and H-1	26.15	33.55
3393	58.2	Lagoon Drive and H-1	5.33	52.87
1997	23.9	Sand Island Access Road and Nimitz Highway	8.10	15.80
3268	33.1	Pu'uhale Road and Nimitz Highway	4.52	28.58
3257	31.6	Mokauea Street and Nimitz Highway	21.31	10.29
3185	32.8	Kalihi Street and Nimitz Highway	12.31	20.49
3175	32.4	Waiakamilo Road and Nimitz Highway	14.46	17.94
3173	19.2	Alakawa Street and Nimitz Highway	15.41	3.79
3148	34.2	Pacific Street and Nimitz Highway	24.78	9.42
2599	23.8	River Street and Nimitz	16.84	6.96
2550	24.2	Smith Street and Nimitz	252.49	NA
			Average Diff	-21.1927
			Average Diff	14.15971

NA=removed outlying data

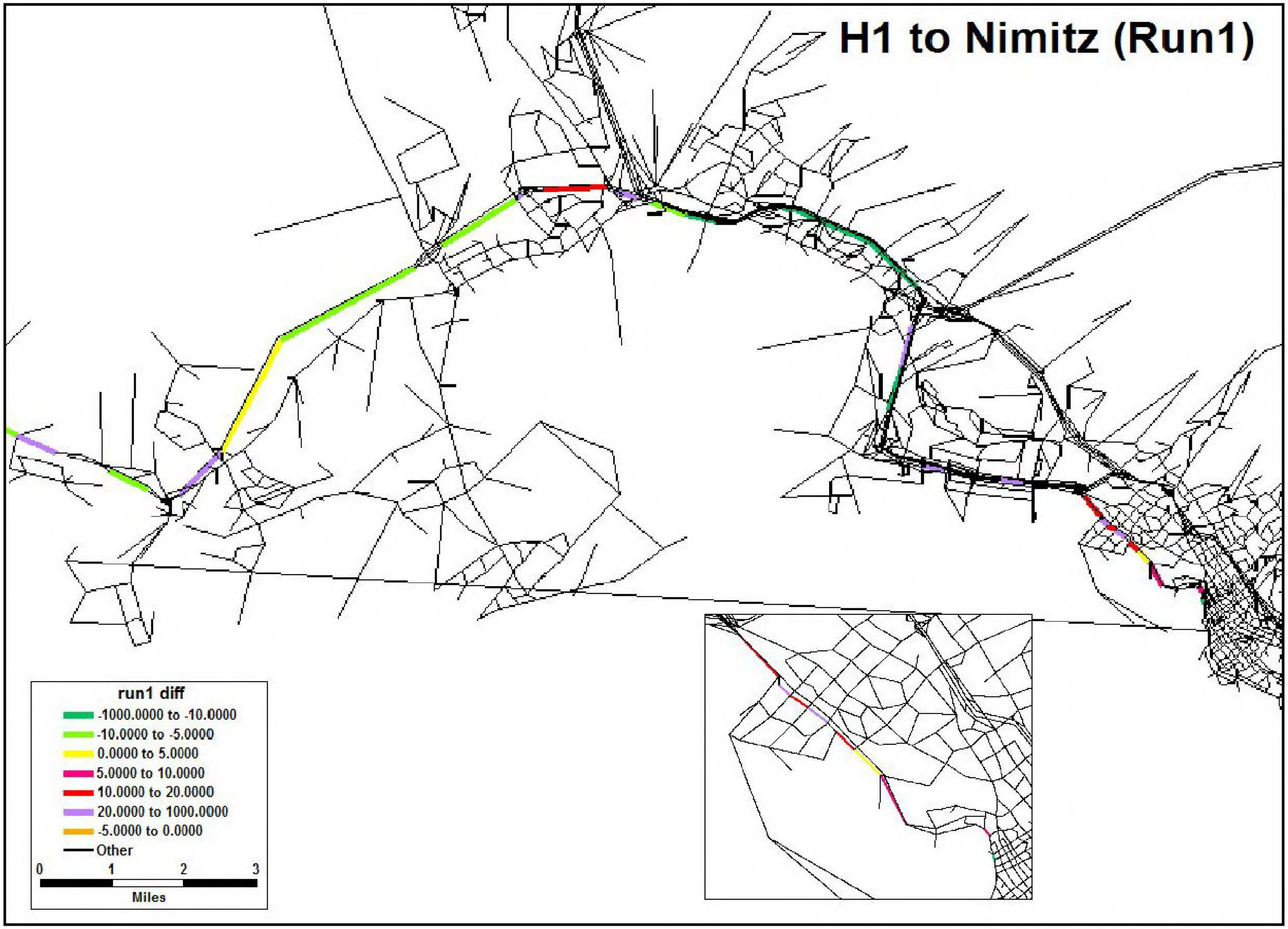

Figure 3-7: Route H-1 #1

Table 3-18: Route H-1 #1 Zipper Farrington Highway (from Mākaha) to H-1 Eastbound to Nimitz Highway (in zipper lane where applicable)

ID	Model Con-gested Speed	Speed Study Section Name	Peak Zipper Speed	Difference (Model-Study)
4114	33.2	Wai'anae Valley Road and Farrington Highway	27.49048962	5.70951
4097	39.9	Hakima Street and Farrington Highway	30.55334261	9.346657
4091	33	Lualualei Naval Road and Farrington Highway (McDonalds)	28.49855831	4.501442
4709	23.6	Nānākuli Avenue and Farrington Highway	20.34736129	3.252639
4109	44.9	Ali'inui Drive (Ko 'Olina Exit eastbound) and Farrington Highway	46.6070859	-1.70709
4065	62	Makakilo Drive and H-1	58.06092912	3.939071
3913	59.4	Pālehua Road and H-1	62.96386949	-3.56387
3877	65.6	Kunia Road (Exit 5 eastbound) and H-1	39.39241831	26.20758
4035	59.4	Kunia Road (Exit 5 eastbound) and H-1	39.39241831	20.00758
3887	29.3	Naval Access Road (Military Road) and H-1	23.55512228	5.744878
4170	58	Paiwa Street and H-1	44.73863636	13.26136
4182	56.5	Waipahu Street and H-1	46.38613198	10.11387
4166	56.5	Farrington Highway Overpass and H-1 (Waiawa Interchange)	32.0885244	24.41148
4172	26.3	Waiawa Road Underpass and H-1	28.12467328	-1.82467
4159	25.1	Lehua Avenue (Pearl City Viaduct) and H-1	32.55103765	-7.45104
4151	25.1	Kaahumanu Overpass and H-1	32.20035911	-7.10036
4149	25.1	Kaonohi Overpass and H-1	36.9736038	-11.8736
4147	25.1	Kaimakani Overpass and H-1	38.94987744	-13.8499
4141	25.1	Salt Lake Boulevard and H-1	39.49194035	-14.3919
4139	25.1	Radford Drive and H-1	49.23494872	-24.1349
4128	64.3	Airport Exit (eastbound) and H-1	53.16815744	11.13184
4124	61.4	Lagoon Drive and H-1	35.49415584	25.90584
1997	23.9	Sand Island Access Road and Nimitz Highway	12.68060932	11.21939
3268	33.1	Pu'uhale Road and Nimitz Highway	16.05634009	17.04366
3257	31.6	Mokauea Street and Nimitz Highway	24.6649456	6.935054
3185	32.8	Kalihi Street and Nimitz Highway	7.507974482	25.29203
3175	32.4	Waiakamilo Road and Nimitz Highway	12.80574073	19.59426
3173	19.2	Alakawa Street and Nimitz Highway	13.42640013	5.7736
3148	34.2	Pacific Street and Nimitz Highway	11.99039476	22.20961
2599	23.8	River Street and Nimitz Highway	23.89504667	-0.09505
2550	24.2	Smith Street and Nimitz Highway	15.0150634	9.184937
		Average Difference	12.51524372	
		Average Difference	-11.51806291	
		Average Difference	15.42902182	

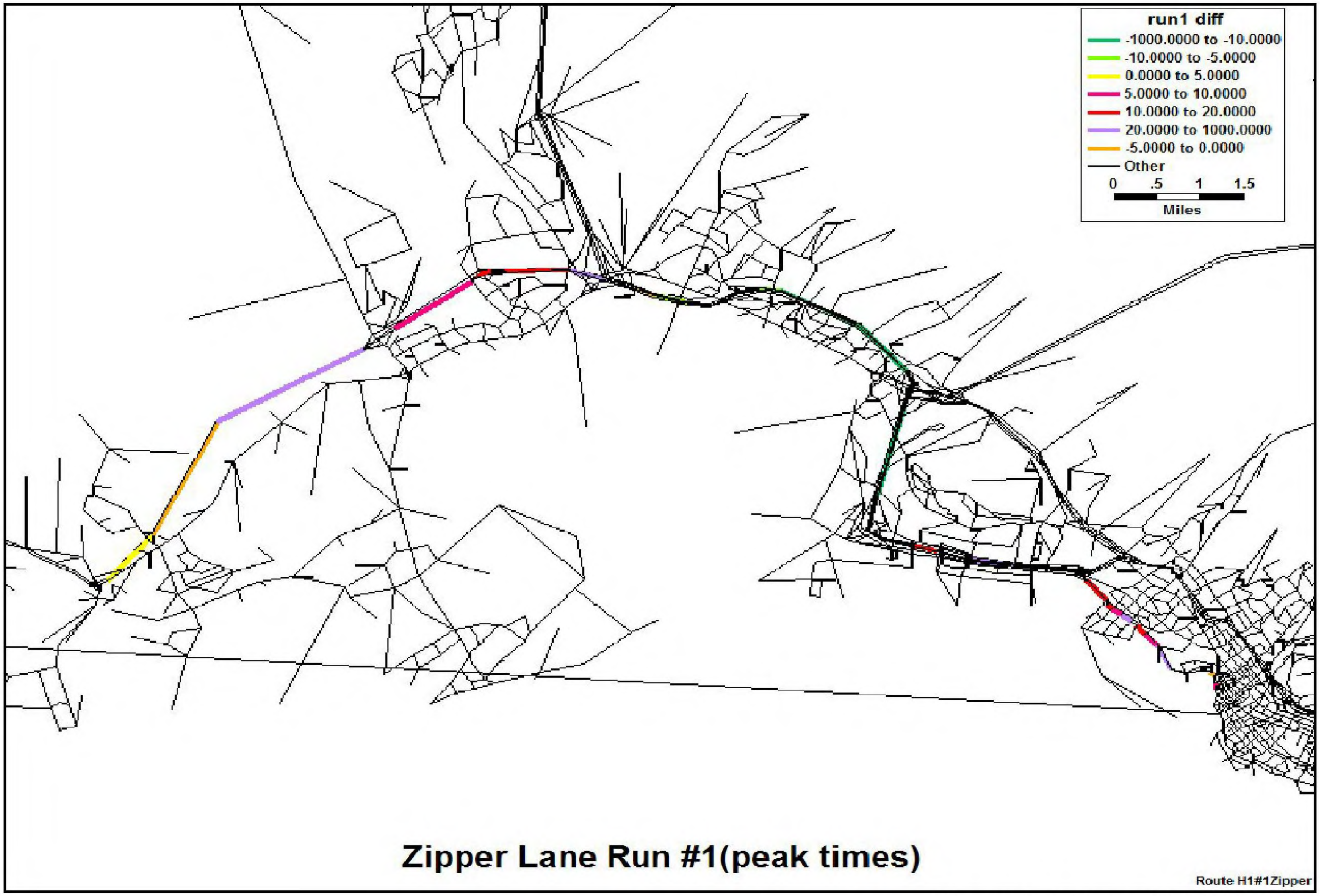

Figure 3-8: Route H-1 #1 Zipper

Table 3-19: Route H-1 #2—Fort Barrette Road (from Kapolei) to H-1 to Paiwa Street (in Waipahu)

ID	Model Congested Speed	Speed Study Section Name	Speed Study Average Speed	Difference*
3904	28.7	Kapolei and Fort Barrette Road	18.204879	10.49512
3907	33.9	Farrington Highway and Fort Barrette Road	23.661981	10.23802
3912	0.5	On ramp from Fort Barrette Road	48.944438	-48.4444
3913	59.4	Pālehua Road and H-1	61.097807	-1.69781
4035	59.4	Kunia Road (Exit 5) and H-1	48.244272	11.15573
3887	29.3	Military Access Road and H-1	57.532558	-28.2326
4178	51	Paiwa Street and H-1 (left turn at Paiwa eastbound)	25.562989	25.43701

*Difference is Model minus Speed Study

Table 3-20: Route H-1 #3—Fort Weaver Road (from 'Ewa Beach) to H-1 to Paiwa Street

ID	Model Congested Speed	Speed Study Section Name (Route 3)	Peak Hour Speed	Difference
3865	56.8	Waipahu Street and Fort Weaver Road	35.238419	21.561581
3867	14.3	Honowai Street and Fort Weaver Road	34.705750	-20.40575
3868	52	H-1 from on-ramp from Fort Weaver Road/Kunia Road	32.103938	19.896062
3887	29.3	Naval Access Road (Military Road) and H-1	59.516608	-30.216608
3893	27.2	Kolowaka Drive and Fort Weaver Road	9.973963	17.226037
3894	34.1	Geiger Road and Fort Weaver Road	16.9414310	17.158569
4011	34.7	Kāwā Drive (Old Fort Weaver Road) and Fort Weaver Road	39.793982	-5.093982
4012	17.3	Laulaunui Street and Fort Weaver Road	48.133308	-30.833308
4046	34.9	Renton Road and Fort Weaver Road	26.166212	8.733788
4552	59	Farrington Highway Overpass and Fort Weaver Road	39.591728	19.408272
4785	32.9	Hanakahi Street and Fort Weaver Road	25.102063	7.797937
4786	31.6	Kuhina Street and Fort Weaver Road	25.758028	5.841972
4788	33.5	Pāpipi Road and Fort Weaver Road	33.471348	0.028652
7946	31.8	Kaimalie Street and Fort Weaver Road	22.142652	9.657348

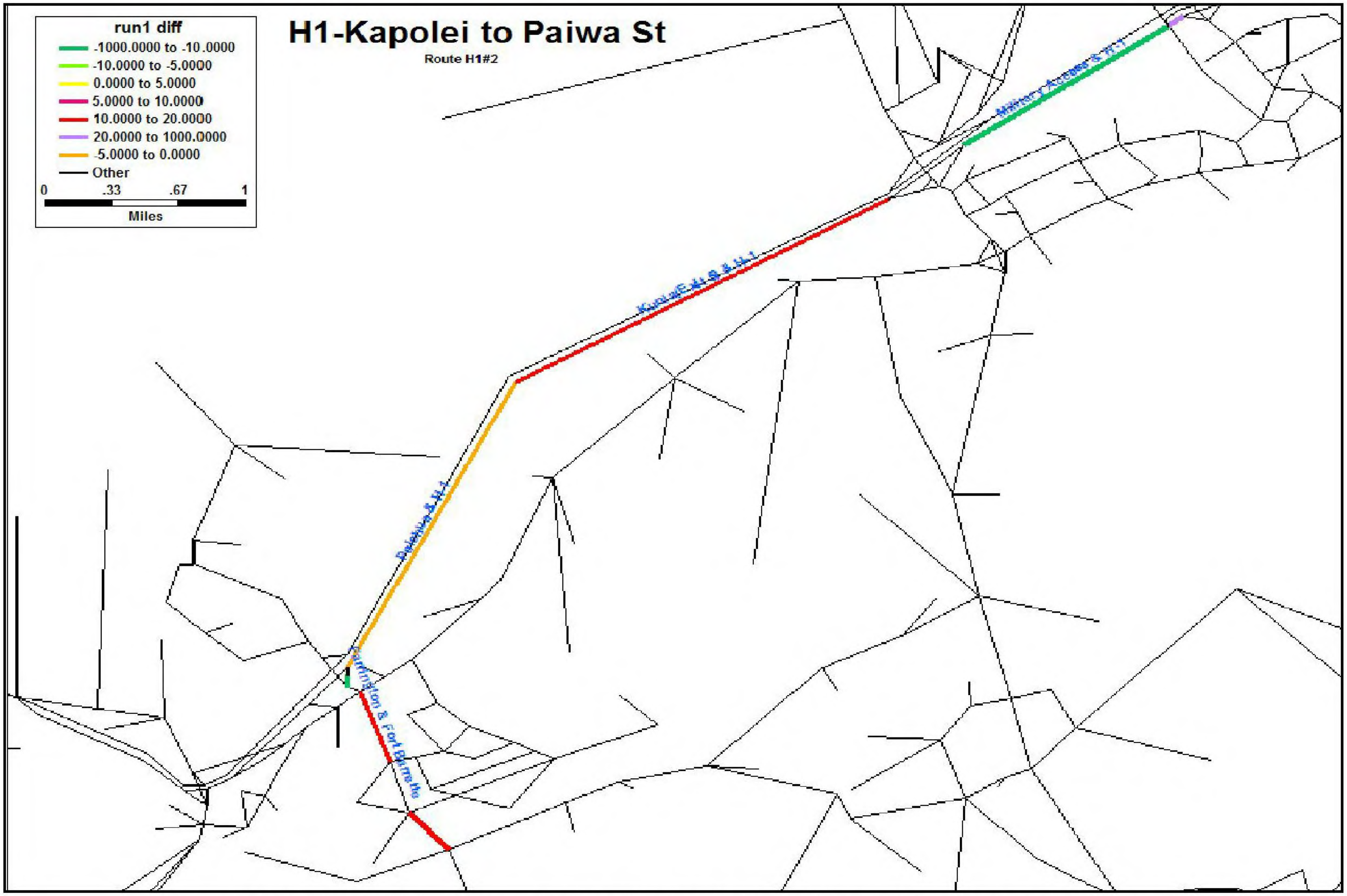

Figure 3-9: Route H-1 #2—Fort Barrette Road (from Kapolei) to H-1 to Paiwa Street (in Waipahu)

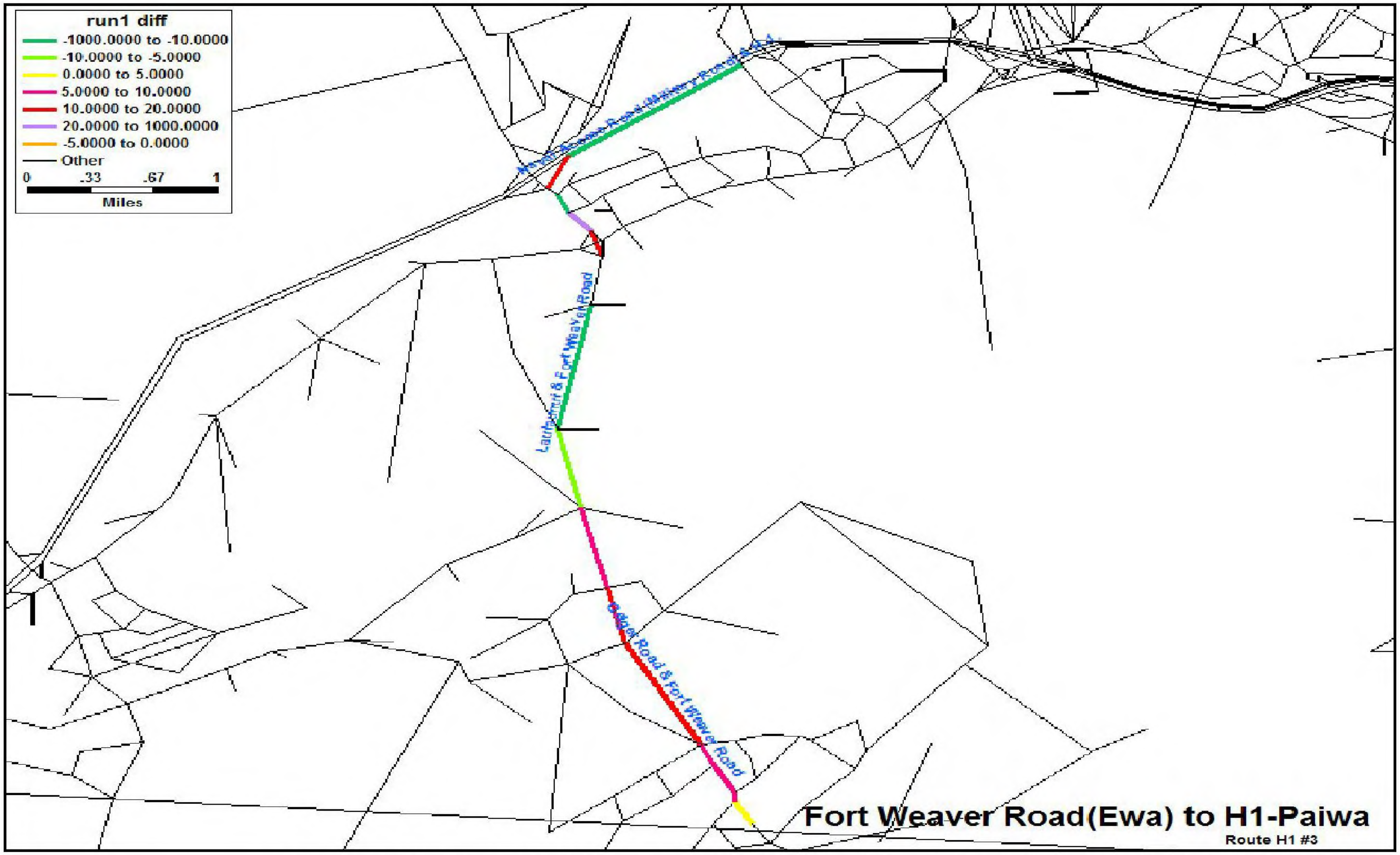

Figure 3-10: Route H-1 #3—Fort Weaver Road (from ‘Ewa beach) to H-1 to Paiwa Street

Table 3-21: Farrington Highway (from Leokū) to Moanalua Road to Waimano Home Road

ID	Model Congested Speed	Speed Study Section Name (Route 4)	Peak Hour Speed	Difference
4446	27.8	Pupukahi Street and Farrington Highway	14.25234154	13.54765846
3850	33.2	Waipahu Depot Road and Farrington Highway	11.03927801	22.16072199
3844	31.7	Mokuola Street and Farrington Highway	4.32550058	27.37449942
3831	31.1	Paiwa Street/Awanui Street and Farrington Highway	4.4955114	26.6044886
3817	31.2	Kahualii Street and Farrington Highway	4.477222691	26.72277731
5459	55	H-1 from on-ramp from Farrington Highway	28.73226494	26.26773506
3754	15.2	Waiawa Road Underpass and H-1	30.36518798	-15.16518798
7443	14.5	Lehua Avenue (Pearl City Viaduct) and H-1	30.66163832	-16.16163832
5606	51	Waimalu Exit and H-1	19.52325667	31.47674333
3952	32.7	Moanalua Road and Waimalu Exit Ramp	24.46886392	8.23113608
3725	26.9	Moanalua Road and Hoomalu Street	10.7008992	16.1991008
3726	32	Moanalua Road and Ho'olaule'a Street	38.2285571	-6.2285571
3731	30.8	Moanalua Road and Waimano Home Road	5.633214476	25.16678552
3734	34.4	Waimano Home Road and Ho'olaule'a Street	14.73507069	19.66492931
3733	32.4	Waimano Home Road and Kamehameha Highway	14.47645502	17.92354498
3737	32.7	Kamehameha Highway and Acacia Road	34.57628038	-1.87628038
3818	14.4	Farrington Highway and Kahualii	26.67462665	-12.27462665
			Average Diff	23.77964681

Table 3-22: Route H-1 #5—H-2 (at Mililani) to H-1 to H-201 to Pali Highway (into Downtown)

ID	Model Congested Speed	Speed Study Section Name (Route 5)	Speed Study Peak Speed	Difference
4823	37.5	Meheula Parkway and Makaikai Street	8.90	28.60
4589	27.9	Meheula Parkway and Ainamakua Drive	3.28	24.62
4598	2.2	H-2 from Meheula Parkway on-ramp*	16.46	-14.26
4574	63	H-2 and Ka Uka Boulevard Overpass	45.67	17.33
8424	60.2	H-2 at H-1/Waipahu Exit	40.28	19.92
3756	36.7	H-1 and Farrington Highway Overpass	27.33	9.37
3754	15.2	Waiawa Road Underpass and H-1	27.42	-12.22
7443	14.5	Lehua Avenue (Pearl City Viaduct) and H-1	45.54	-31.04
3960	20.1	Kaahumanu Overpass and H-1	44.89	-24.79
7445	20.1	Kaonohi Overpass and H-1	30.64	-10.54
7449	16.8	Kaimakani Overpass and H-1	37.24	-20.44
3992	37.3	Āliamanu Drive Underpass and H-201	39.94	-2.64
8361	43.1	Ala Napunani Overpass and H-201	34.46	8.64
2998	57.2	Funston Road Overpass and H-201	17.14	40.06
2969	55.4	Middle Street Overpass and H-201	10.03	45.37
2926	12.8	Gulick Avenue Overpass and H-1	10.36	2.44
2916	51.8	Kalihi Street Overpass and H-1	8.35	43.45
2885	44	Houghtailing Street Underpass and H-1	19.27	24.73
8272	20.2	Palama Street Underpass and H-1	18.04	2.16
8269	19.6	Liliha Street Overpass and H-1	20.52	-0.92
2798	14.4	Nuʻuanu Street Overpass and H-1	21.41	-7.01
2784	21	Pali Highway and H-1	10.41	10.59
2432	57.8	Pali Highway and Vineyard Boulevard	11.33	46.47
2435	18.8	Pali Highway and Beretania Street	11.72	7.08
2445	22.1	Bishop Street and Hotel Street	13.63	8.47
			Ave Diff	19.97
			Ave Diff	-19.80

Average would be misleading but generally way over

*Removed on ramp from calculation

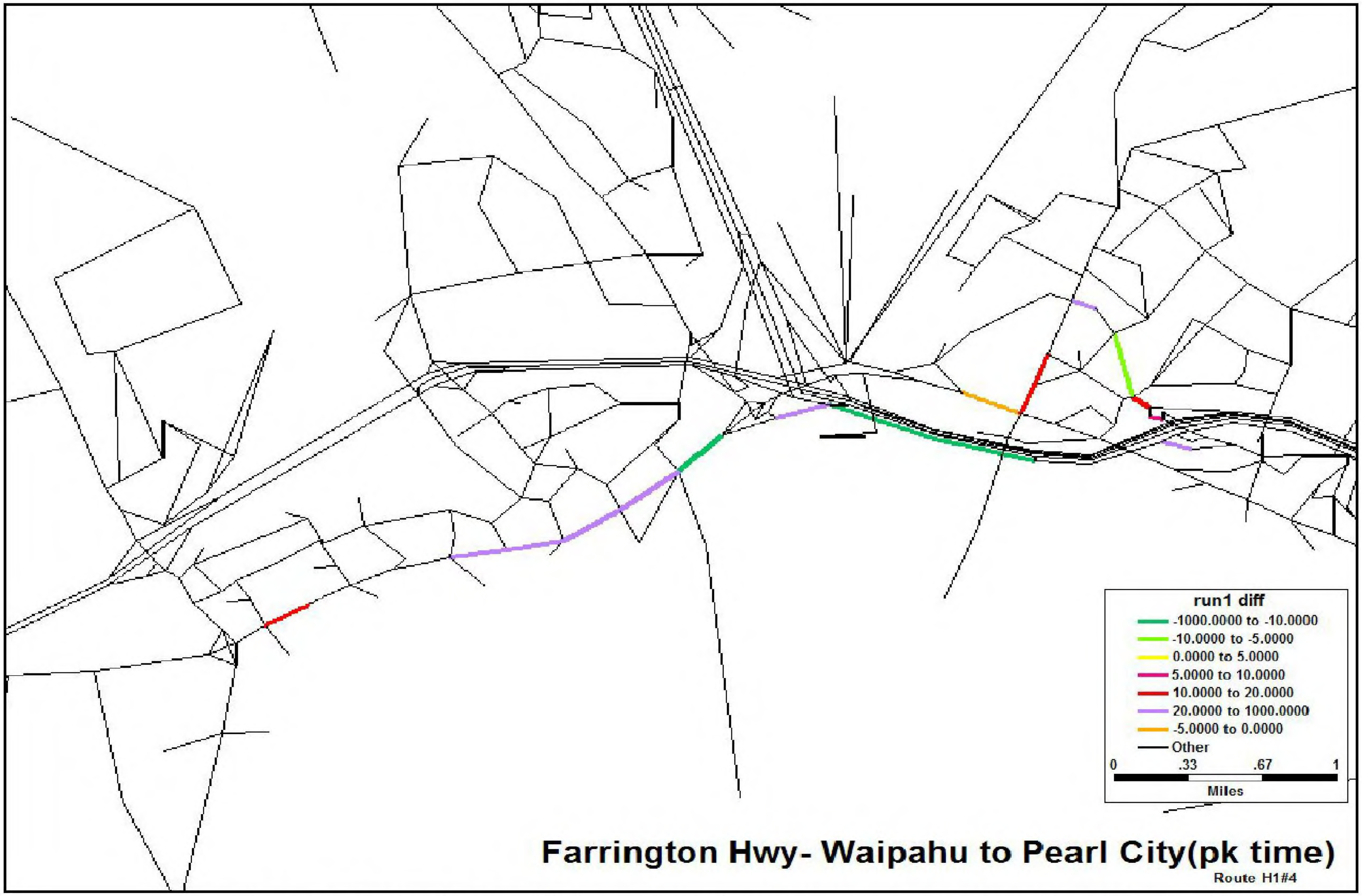

Figure 3-11: Farrington Highway (from Leokū) to Moanalua Road to Waimano Home Road

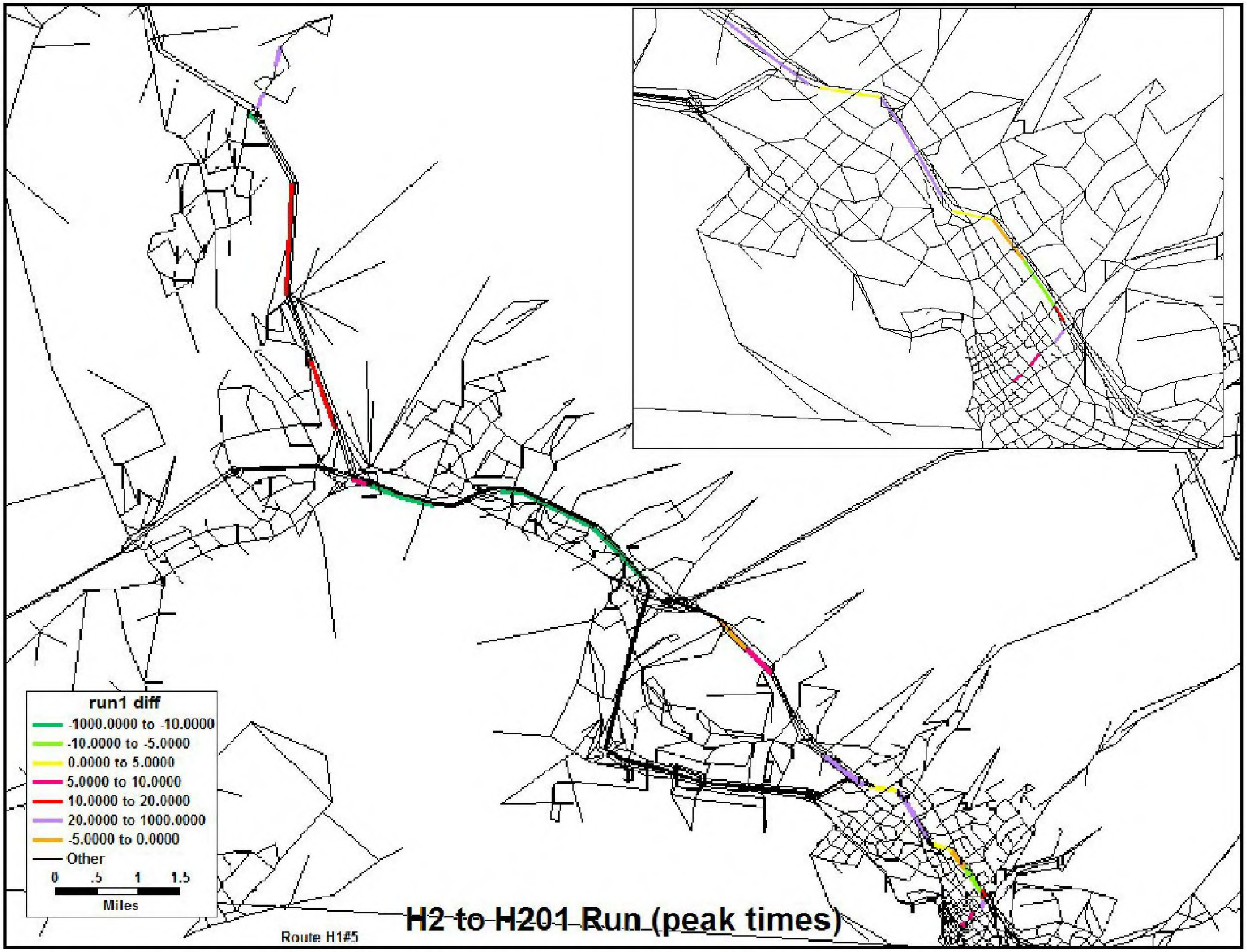

Figure 3-12: Route H-1 #5—H-2 (at Mililani) to H-1 to H-201 to Pali Highway (into Downtown)

Table 3-23: Route H-1 #5 HOV—H-2 (at Mililani) to H-1 to H-201 to Pali Highway (into Downtown) (uses HOV lanes)

ID	Model Congested Speed	Speed Study Section Name (Route 5)	Difference
4823	37.5	Meheula Parkway and Makaikai Street	16.34052
4589	27.9	Meheula Parkway and Ainamakua Drive	12.18332
4598	2.2	H-2 from Meheula Parkway on-ramp*	-20.948
4574	63	H-2 and Ka Uka Boulevard Overpass	10.21536
8423	57.6	H-2 at H-1/Waipahu Exit	8.955847
4163	26.3	H-1 and Farrington Highway Overpass	12.43315
4172	26.3	Waiawa Road Underpass and H-1	-40.5843
4159	25.1	Lehua Avenue (Pearl City Viaduct) and H-1	-29.3806
4151	25.1	Kaahumanu Overpass and H-1	-29.913
4149	25.1	Kaonohi Overpass and H-1	-27.3831
4147	25.1	Kaimakani Overpass and H-1	-13.1925
		Average Difference	11.92376
		Average Difference	-21.3367

*Removed because it is the on-ramp speed

As a general conclusion, the freeway speeds from the travel demand model were determined to be higher than the actual observed travel times on an average of 12 to 25 mph depending on the corridor. These higher speeds could affect the transit ridership of the model in both the base and future. The future speeds should be lower and thus could provide for better transit ridership as people shift modes due to the congestion levels and slower speeds. Origin/destination estimation techniques were tested but didn't produce reliable enough results to change the model speeds. In the future, a new estimation technique should be developed and applied using actual ground counts to assist in the adjustment of the assigned traffic and model speeds.

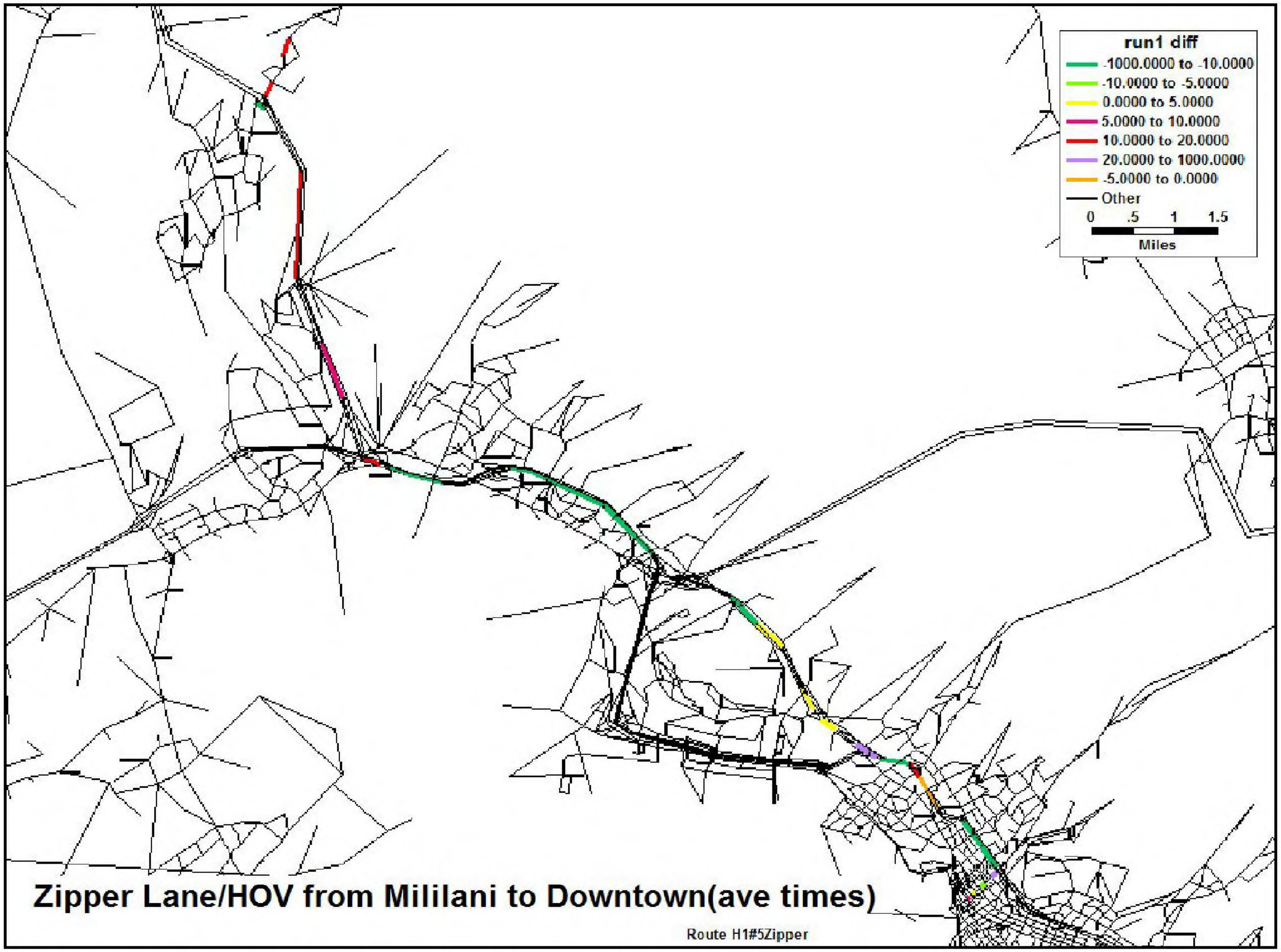

Figure 3-13: Route H-1 #5 HOV—H-2 (at Mililani) to H-1 to H-201 to Pali Highway (into Downtown)

3.1.5 Tests of Alternative Highway Volume-Delay Functions

The O‘ahuMPO travel demand model produced highway speeds that were too fast for base and future scenarios using the Akçelik volume delay function (VDF). The nature of the Akçelik curves has shown that delay does not become appreciable until volume to capacity (V/C) ratio is greater than or equal to 1.0. So, a facility could have a V/C ratio of 0.9 with the highway operating at near free-flow conditions. In addition, because of the extreme sensitivity of the Akçelik curves around V/C=1.0, congested speeds tend to be highly variable along corridors.

A more gradual VDF produces more reasonable travel speeds and leads to more stable and predictable results in the model. This section documents a test of other VDFs used throughout the country as well as the VDFs used in the past O‘ahuMPO travel demand models.

Current Volume Delay Functions used in O‘ahuMPO Model

Akçelik VDFs were used in the previous version of the O‘ahuMPO travel demand model. The VDFs were developed using a speed-flow relationship developed by Rupinder Singh based on a speed-flow model originally developed by Akçelik. This speed-flow relationship is much more sensitive than the “classical” Bureau of Public Roads (BPR) curves—that is, at volume capacity ratios of more than 1.0, the Akçelik formulation will show much lower speeds (and higher times) than the standard formulation. There are five specifications, for various facility types, plus a general specification and a “do nothing” formulation for centroids.

The Akçelik speed-flow model has the mathematical formulation of:

$$t = t_o + \{0.25T[(x-1) + \{(x-1)^2 + (8J_a x/QT)\}^{0.5}]\}$$

where:

- t = average travel time per unit distance (hours/mile)
- t_o = free-flow travel time per unit distance (hours/mile)
- T = flow period, i.e., the time interval in hours, during which an average arrival (demand) flow rate, v, persists
- Q = Capacity
- x = the degree of saturation i.e., v/Q
- J_a = the delay parameter

For the O‘ahuMPO model, there were different delay parameters by facility type. These delay (J_a) parameters were:

- Freeways, expressways, and high speed ramps—0.8
- Arterial I—1.6
- Arterial II and III—3.2
- Collector I—6.4
- Collector II, local streets, and low speed ramps—12.8
- Centroid connectors—no adjustment made to these links

Figure 3-14 displays the degradation in speed by the delay factors by facility type and V/C ratio.

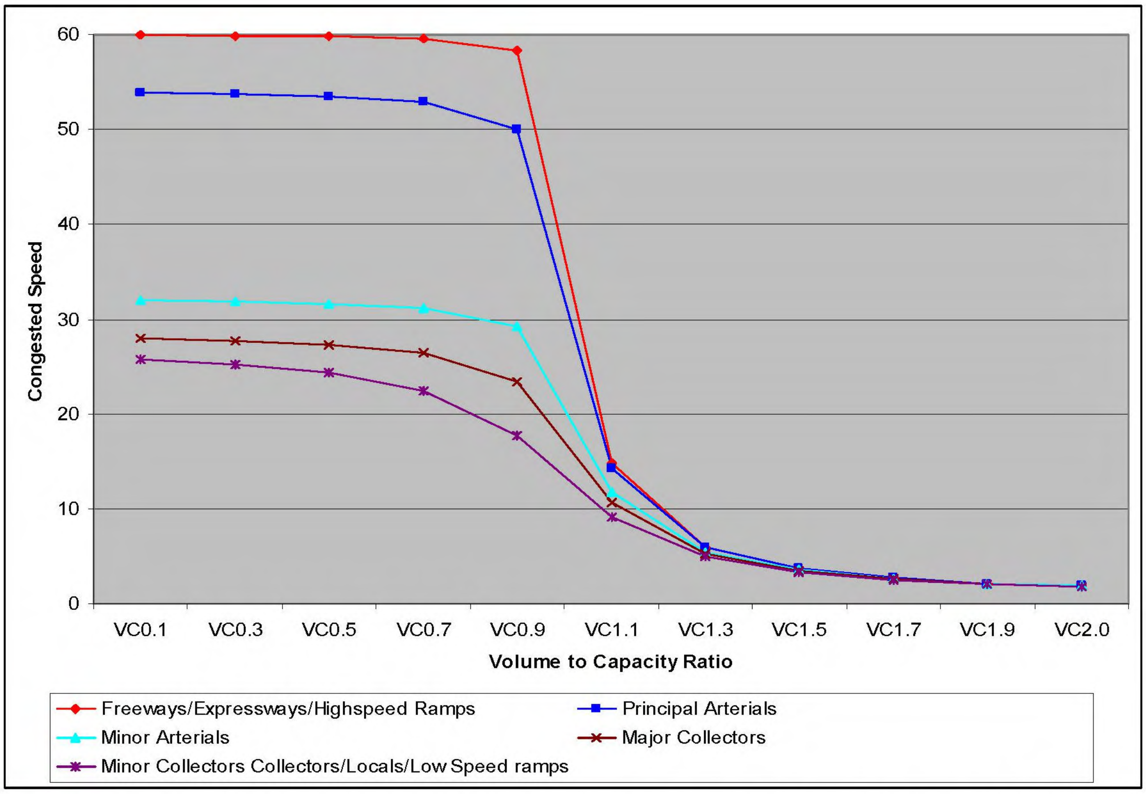

Figure 3-14: Akçelik Curve Speed Degradation for the O'ahuMPO Model

The graph shows that speeds do not start to degrade until V/C reaches 1.0. When the speed does start to degrade, it degrades dramatically.

Previous Volume Delay Functions used in O'ahuMPO Model

The functions used in the 1995 version of the O'ahuMPO travel demand model were similar to BPR VDFs. Table 3-24 shows the delay factor used by facility type and V/C ratio.

Table 3-24: VDFs used in 1995 O'ahuMPO Travel Demand Model

Functional Class	Volume to Capacity Ratio							
	V/C=0.1	V/C=0.3	V/C=0.5	V/C=0.7	V/C=0.9	V/C=1.1	V/C=1.3	V/C=1.5
Freeways	1.01	1.02	1.05	1.12	1.4	3.4	7.12	11.05
Expressways	1.01	1.04	1.09	1.19	1.53	2.83	5.09	7.59
Principal arterial	1.02	1.07	1.15	1.31	1.67	2.84	4.42	6.22
Minor arterial	1.03	1.09	1.2	1.39	1.74	3	4.58	6.35
Major collector	1.03	1.04	1.06	1.1	1.18	1.34	1.66	2.3
Minor collector	1.03	1.04	1.06	1.1	1.18	1.34	1.66	2.3
Freeway ramp	1.03	1.09	1.2	1.39	1.74	3	4.58	6.35

Figure 3-15 shows that the congested speeds degrade gradually as the V/C ratio increases.

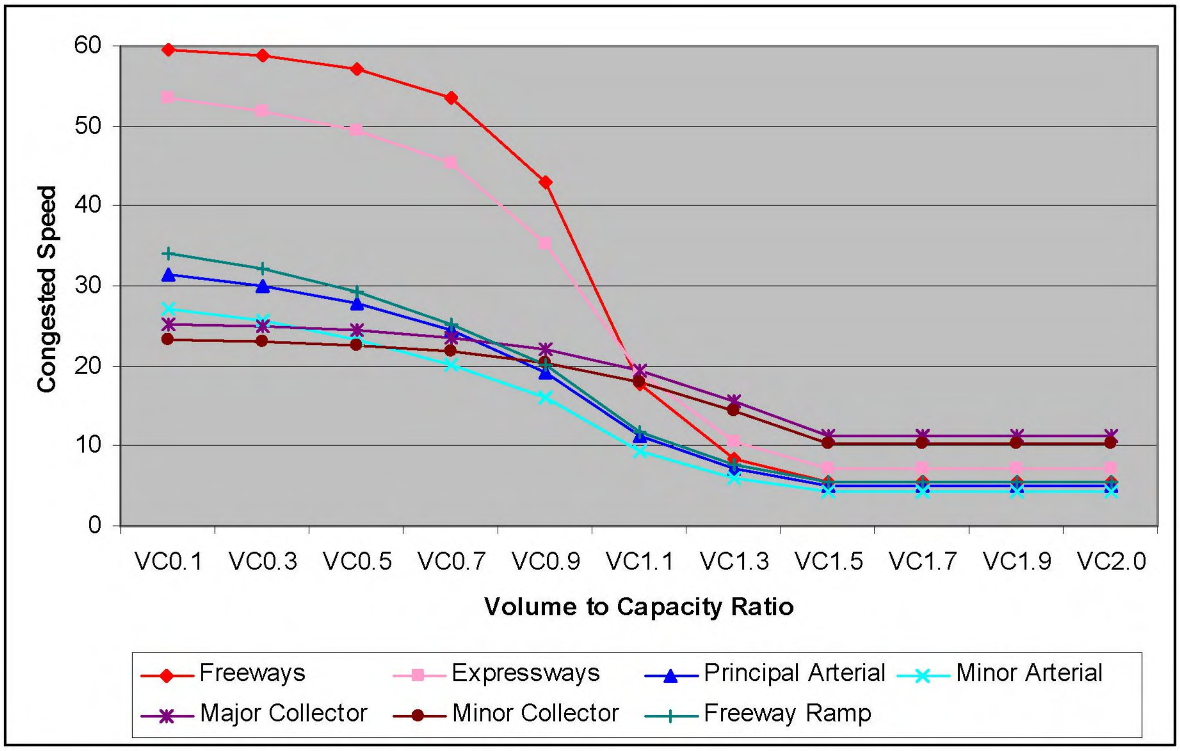

Figure 3-15: Volume Delay Functions—1995 O'ahuMPO Travel Demand Model Speed Degradation

Conical Volume Delay Functions

A new class of functions named conical volume-delay functions, due to its geometrical interpretation as hyperbolic conical sections, was developed by Heinz Spiess.

The conical congestion function is defined as:

$$T^C(x) = T_0 * (2 + \sqrt{\alpha^2(1-x)^2 + \beta^2} - \alpha(1-x) - \beta)$$

where:

β is given as $\beta = \dfrac{2\alpha - 1}{2\alpha - 2}$
α is any number larger than 1
$T^c(x)$ = average travel time per unit distance (hours/mile)
T_o = free-flow travel time per unit distance (hours/mile)
x = volume to capacity

The alpha values used to specify these curves are:

- Freeway—10.0
- Expressway—6.5
- Principal arterial—5.2
- Minor arterial—5.2
- Major collector—4
- Minor collector—2
- Ramps—5.3

The alpha values are roughly equivalent to the exponent in the BPR function. As the exponent increases, the slope of the curve at V/C=1.0 also increases. As with the BPR exponent, we would expect higher values for freeways and expressways versus arterials and collectors. These values were chosen to more closely follow the previous look-up tables of the 1995 model.

The conical functions in Figure 3-16 provide an almost identical speed degradation pattern as the functions used in the 1995 O‘ahuMPO travel demand model.

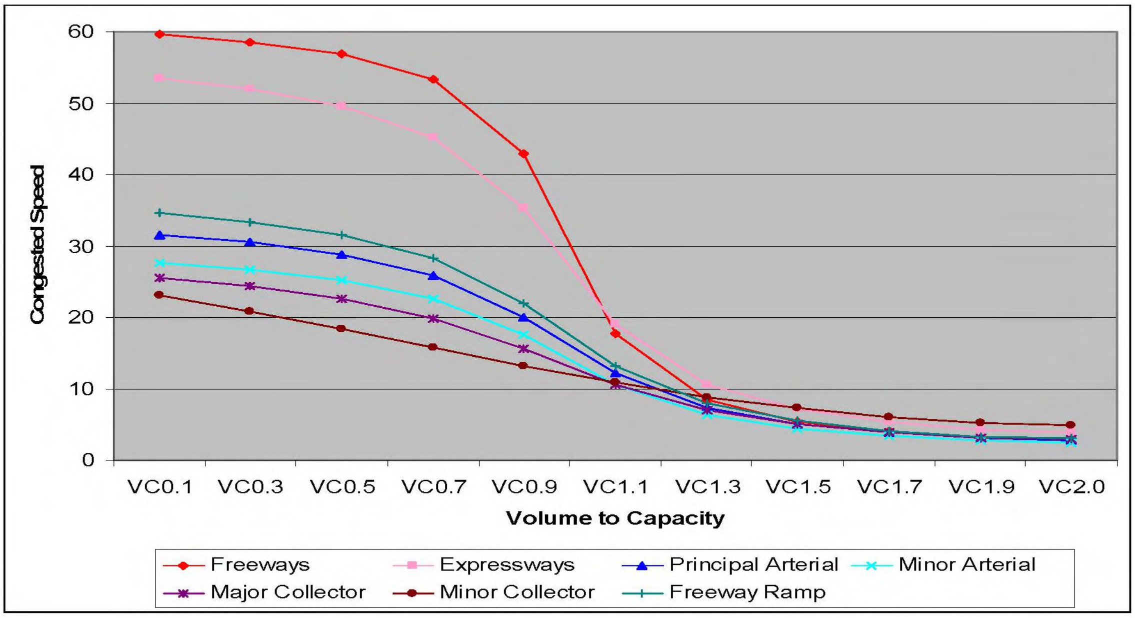

Figure 3-16: Conical Volume Delay Functions Speed Degradation

Volume Delay Function Comparisons

As seen in Figure 3-16, the conical curve formulation allows a gradual degradation of speeds as V/C ratios rise. Thus, vehicle hours traveled (VHT) using the Akçelik functions (296,909) were significantly less than VHT using either the Conical functions (309,104) or the VDFs for the 1995 O'ahuMPO model (307,795). Table 3-25 through Table 3-27 compare the vehicle miles traveled (VMT) and VHT by facility type for the 2000 base year model run using the three different VDFs. As expected, the differences are more pronounced in the horizon year transit alternative shown in Table 3-28 through Table 3-30.

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Table 3-25: Akçelik Volume Delay Functions—2000 Base Year Vehicle Miles Traveled and Vehicle Hours Traveled

Facility Type	AM Peak VMT	Off-peak VMT	PM Peak VMT	Total VMT	AM Peak VHT	Off-peak VHT	PM Peak VHT	Total VHT
Freeways	1,353,584	2,029,928	1,449,958	***4,833,470***	31,652	31,062	28,229	***90,943***
Expressways	373,723	583,072	419,511	***1,376,306***	7,265	9,437	7,304	***24,006***
Class I arterials	482,667	575,702	568,008	***1,626,377***	16,509	15,019	18,412	***49,940***
Class II arterials	377,644	504,669	423,774	***1,306,087***	11,158	13,427	11,565	***36,150***
Class III arterials	139,133	202,369	159,697	***501,198***	5,107	6,154	5,333	***16,594***
Class I collectors	126,783	185,672	151,101	***463,556***	4,665	6,141	5,548	***16,354***
Class II collectors	195,017	288,662	231,105	***714,784***	7,624	9,730	8,770	***26,123***
Local streets	58,077	85,924	65,749	***209,750***	5,438	4,275	6,267	***15,979***
High-speed ramps	72,921	120,415	77,811	***271,147***	1,935	2,303	2,731	***6,968***
Low-speed ramps	28,392	64,922	36,196	***129,510***	3,375	4,613	5,863	***13,851***
Total	***3,207,939***	***4,641,335***	***3,582,910***	***11,432,184***	***94,728***	***102,159***	***100,022***	***296,909***

Table 3-26: 1995 O'ahuMPO Model Volume Delay Functions—2000 Base Year Vehicle Miles Traveled and Vehicle Hours Traveled

Facility Type	AM Peak VMT	Off Peak VMT	PM Peak VMT	Total VMT	AM Peak VHT	Off Peak VHT	PM Peak VHT	Total VHT
Freeways	1,326,646	2,013,819	1,417,377	***4,757,841***	34,654	32,530	29,801	***96,986***
Expressways	367,610	569,496	415,230	***1,352,336***	8,226	9,602	8,441	***26,269***
Class I arterials	452,085	574,412	528,566	***1,555,064***	16,508	15,938	19,871	***52,316***
Class II arterials	365,133	490,268	418,690	***1,274,091***	12,736	13,678	13,831	***40,245***
Class III arterials	135,929	196,966	154,744	***487,639***	5,492	6,473	6,101	***18,067***
Class I collectors	123,411	178,725	150,130	***452,266***	4,644	6,172	5,917	***16,733***
Class II collectors	200,214	283,692	241,401	***725,306***	7,435	9,897	9,149	***26,480***
Local streets	64,590	85,520	71,778	***221,888***	2,972	3,951	3,414	***10,337***
High-speed ramps	70,766	115,301	73,974	***260,042***	2,192	2,550	2,345	***7,088***
Low-speed ramps	29,692	62,114	41,274	***133,080***	3,085	4,496	5,693	***13,274***
Total	***3,136,075***	***4,570,313***	***3,513,164***	***11,219,553***	***97,945***	***105,287***	***104,563***	***307,795***

Table 3-27: Conical Volume Delay Functions—2000 Base Year Vehicle Miles Traveled and Vehicle Hours Traveled

Facility Type	AM Peak VMT	Off Peak VMT	PM Peak VMT	Total VMT	AM Peak VHT	Off Peak VHT	PM Peak VHT	Total VHT
Freeways	1,337,632	2,001,038	1,429,655	***4,768,326***	32,352	32,090	30,639	***95,080***
Expressways	366,328	564,819	409,862	***1,341,008***	8,146	9,471	8,103	***25,720***
Class I arterials	452,883	586,849	540,516	***1,580,248***	16,037	16,017	20,015	***52,068***
Class II arterials	361,942	499,288	416,056	***1,277,287***	11,768	13,699	12,968	***38,435***
Class III arterials	135,949	199,752	158,875	***494,576***	5,150	6,336	5,933	***17,418***
Class I collectors	115,535	174,623	139,103	***429,261***	4,824	6,242	5,885	***16,951***
Class II collectors	197,084	294,035	242,089	***733,208***	8,169	10,133	9,838	***28,139***
Local streets	59,706	84,855	68,188	***212,748***	5,859	4,318	5,924	***16,101***
High-speed ramps	80,424	118,441	78,972	***277,837***	1,525	2,262	1,509	***5,296***
Low-speed ramps	26,949	63,019	34,462	***124,430***	3,399	4,724	5,771	***13,894***
Total	***3,134,431***	***4,586,718***	***3,517,779***	***11,238,929***	***97,228***	***105,291***	***106,585***	***309,104***

Table 3-28: Akçelik Volume Delay Functions—2030 Transit Alternative Vehicle Miles Traveled and Vehicle Hours Traveled

Facility Type	AM Peak VMT	Off Peak VMT	PM Peak VMT	Total VMT	AM Peak VHT	Off Peak VHT	PM Peak VHT	Total VHT
Freeways	1,601,670	2,586,236	1,774,839	***5,962,745***	32,050	39,682	35,598	***107,330***
Expressways	444,241	724,261	507,371	***1,675,873***	9,047	11,964	9,766	***30,777***
Class I arterials	549,281	766,267	672,543	***1,988,091***	16,481	19,019	21,557	***57,057***
Class II arterials	458,394	639,352	538,531	***1,636,277***	15,483	16,982	17,505	***49,970***
Class III arterials	173,040	242,340	211,466	***626,846***	5,362	7,360	6,645	***19,367***
Class I collectors	154,411	224,570	193,431	***572,412***	5,160	7,356	7,033	***19,549***
Class II collectors	221,929	323,330	267,031	***812,290***	8,422	11,222	10,418	***30,062***
Local streets	67,361	94,879	75,520	***237,760***	5,404	4,377	4,632	***14,412***
High-speed ramps	83,469	141,788	86,316	***311,573***	1,939	2,697	2,686	***7,322***
Low-speed ramps	36,160	86,236	43,180	***165,576***	3,681	5,538	6,868	***16,087***
Total	***3,789,957***	***5,829,259***	***4,370,227***	***13,989,443***	***103,029***	***126,198***	***122,706***	***351,933***

Table 3-29:1995 O'ahuMPO Model Volume Delay Functions—2030 Transit Alternative Vehicle Miles Traveled and Vehicle Hours Traveled

Facility Type	AM Peak VMT	Off Peak VMT	PM Peak VMT	Total VMT	AM Peak VHT	Off Peak VHT	PM Peak VHT	Total VHT
Freeways	1,599,469	2,589,314	1,782,105	***5,970,888***	38,514	41,823	40,705	***121,042***
Expressways	443,209	707,603	501,299	***1,652,111***	10,675	12,350	11,508	***34,532***
Class I arterials	532,414	776,657	649,412	***1,958,483***	18,851	20,818	24,591	***64,260***
Class II arterials	464,114	630,947	532,734	***1,627,795***	17,224	17,866	19,988	***55,079***
Class III arterials	174,377	242,449	206,712	***623,539***	6,442	7,836	7,891	***22,169***
Class I collectors	157,198	217,849	194,622	***569,669***	5,814	7,475	7,515	***20,804***
Class II collectors	233,009	324,016	284,288	***841,312***	8,874	11,567	11,183	***31,625***
Local streets	75,490	105,305	87,781	***268,577***	3,369	4,676	4,025	***12,069***
High-speed ramps	78,038	139,623	82,520	***300,182***	2,309	3,281	2,632	***8,221***
Low-speed ramps	38,044	81,042	48,957	***168,043***	3,755	5,803	6,632	***16,190***
Total	***3,795,363***	***5,814,805***	***4,370,431***	***13,980,599***	***115,827***	***133,495***	***136,670***	***385,992***

Table 3-30: Conical Volume Delay Functions—2030 Transit Alternative Vehicle Miles Traveled and Vehicle Hours Traveled

Facility Type	AM Peak VMT	Off Peak VMT	PM Peak VMT	Total VMT	AM Peak VHT	Off Peak VHT	PM Peak VHT	Total VHT
Freeways	1,606,050	2,582,639	1,777,862	***5,966,551***	36,601	41,609	41,195	***119,404***
Expressways	440,499	703,647	501,856	***1,646,002***	10,339	12,166	11,454	***33,959***
Class I arterials	536,474	786,254	658,388	***1,981,116***	18,229	20,657	24,098	***62,984***
Class II arterials	459,036	636,882	532,508	***1,628,425***	16,076	17,653	18,646	***52,375***
Class III arterials	175,034	246,059	210,293	***631,385***	6,033	7,736	7,485	***21,254***
Class I collectors	143,444	214,660	178,590	***536,694***	5,747	7,665	7,594	***21,006***
Class II collectors	230,925	333,685	278,096	***842,706***	9,379	11,647	11,582	***32,609***
Local streets	69,436	103,450	82,332	***255,218***	6,223	5,018	5,944	***17,185***
High-speed ramps	90,684	142,804	92,460	***325,948***	1,713	2,714	1,755	***6,182***
Low-speed ramps	35,162	83,098	41,910	***160,170***	3,991	5,856	7,508	***17,355***
Total	***3,786,743***	***5,833,176***	***4,354,296***	***13,974,215***	***114,333***	***132,721***	***137,260***	***384,314***

The following figures display the difference between the various VDFs using the coded congested speed and the AM peak period congested speed from the 2000 base year model. Notice that Figure 3-17 (Akçelik VDFs) has significantly more bold red links, meaning the model's speed is between 15 to 40 mph faster than the observed speed. Table 3-17 (Conicals) and Figure 3-19 (Curve table) show less variation in the link speeds, especially in the Downtown area.

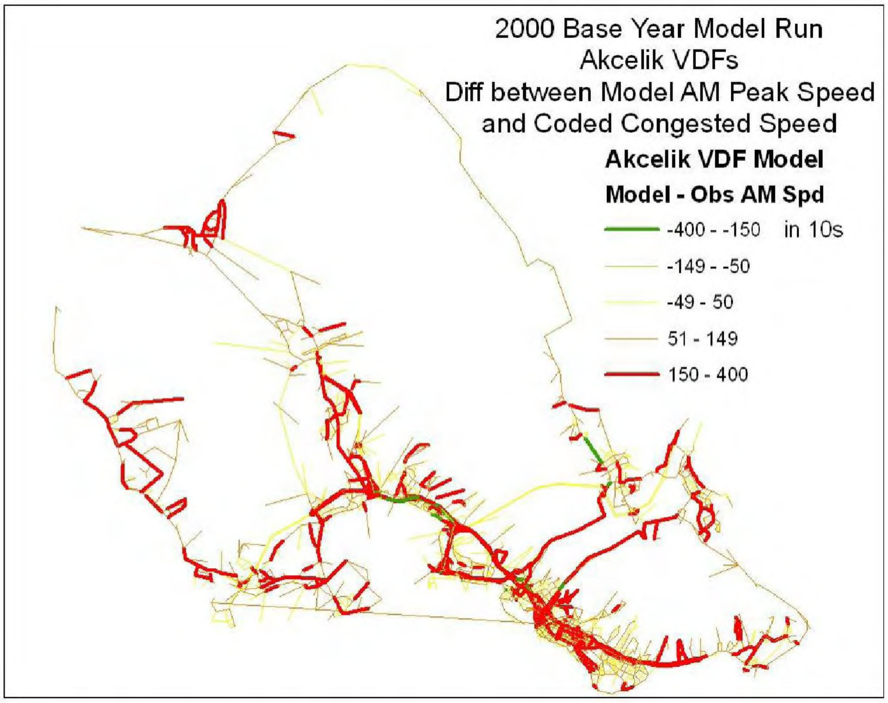


Figure 3-17: Difference between Model AM Congested Speed and Observed Congested Speed with Akçelik Volume Delay Functions

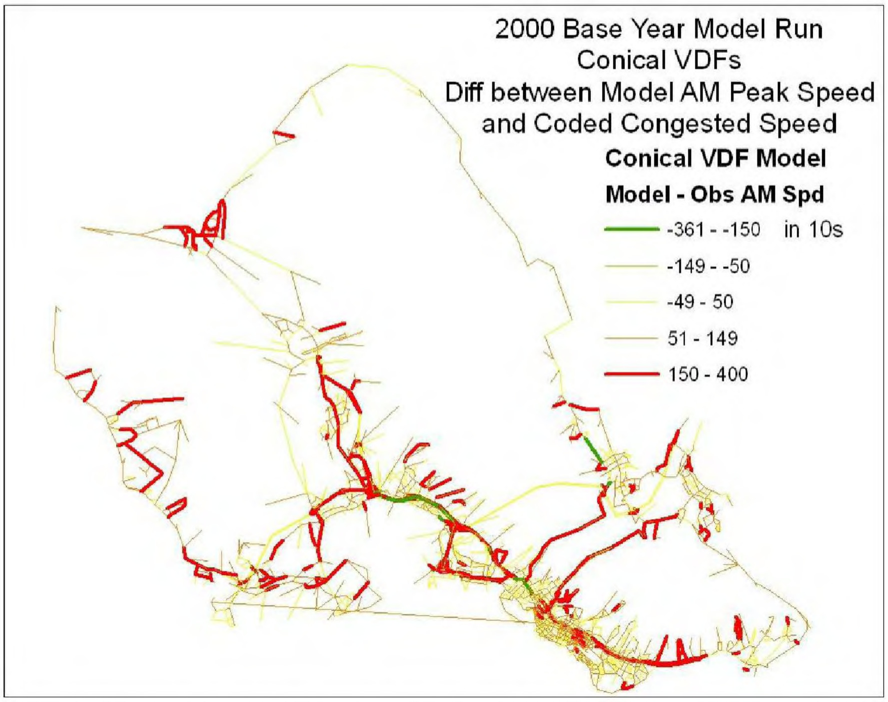


Figure 3-18: Difference between Model AM Congested Speed and Observed Congested Speed with Conical Volume Delay Functions

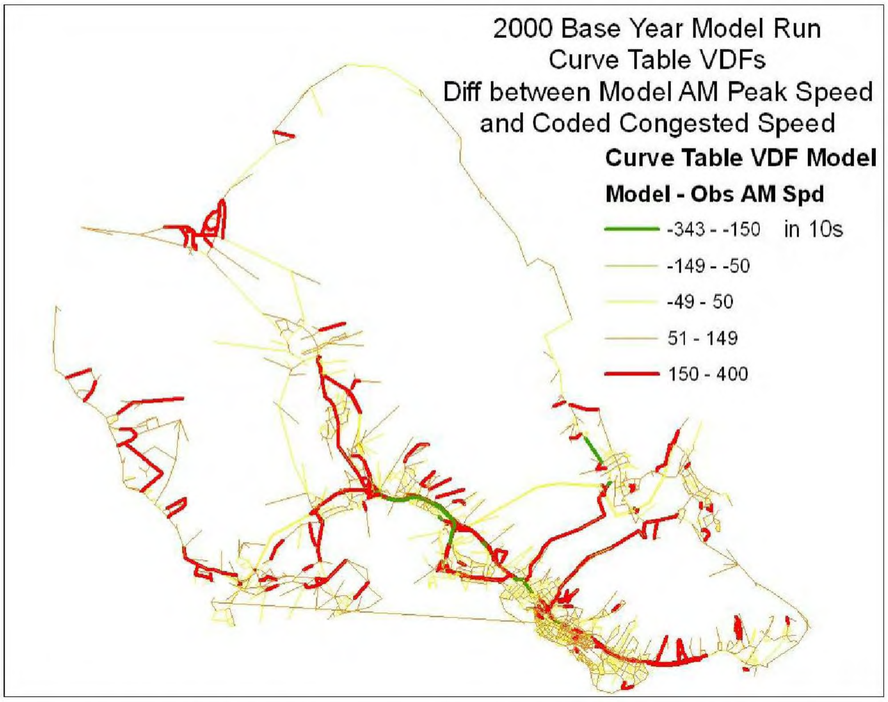


Figure 3-19: Difference between Model AM Congested Speed and Observed Congested Speed with Curve Table Volume Delay Functions

Table 3-31 shows much slower speeds using the conical and curve table VDFs and compliments the results from the previous figures.

The conical and curve table VDFs show that speeds degrade gradually compared to the sharpness displayed on the Akçelik curve function. The conical and curve table VDFs also match observed congested speeds during the peak periods more closely compared to the Akçelik functions. An additional benefit of conical functions is the ease of implementation into the model unlike the additional burden created by using look-up tables (Curve table VDFs). The conclusion of the VDF testing resulted in the replacement of the Akçelik functions by the conical functions in the O‘ahuMPO travel demand model.

Table 3-31: 2000 Base Year Model Run V/C and Corresponding Speeds for Various Screenline Locations

	Model with Akçelik VDFs				Model with Conicals				Model with Curve Table			
	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB
	V/C		SPEED		V/C		SPEED		V/C		SPEED	
University Avenue 'Ewa of UH Campus												
AM	31	75	34	33.8	30	73	32.3	26.6	33	93	32.6	28.2
OP	31	42	34	34	26	34	32.6	32	34	47	32.6	32
PM	47	57	34	33.9	44	52	31.1	30.3	65	66	31.1	31.1
Nimitz Highway at Kapālama Stream												
AM	42	106	37	18.1	45	104	33.8	16.6	43	115	32.9	11.3
OP	14	15	37	37	19	20	35.98	35.9	21	16	35.1	35.5
PM	105	82	19.2	36.9	104	76	16.7	28	85	77	23.3	25.6
Kapi'olani Boulevard near Pi'ikoi Street												
AM	21	85	32	31.7	26	53	30.7	28.3	31	59	29.8	26.1
OP	10	20	32	32	10	21	31.6	30.9	10	20	31.4	30.4
PM	31	36	32	32	54	41	28.3	39.6	57	42	26.3	28.5
Ala Moana Boulevard near Pi'ikoi Street												
AM	57	66	35	34.9	55	62	30.9	29.7	47	65	30.7	27.5
OP	17	17	35	35	21	21	34	34	23	18	33.3	33.7
PM	81	74	34.9	34.9	74	62	27.1	29.6	67	61	27	28.1
South King Street near Pi'ikoi Street												
AM		46		35		50		31.4		46		30.9
OP		19		35		19		34		17		33.6
PM		67		35		64		29.3		62		27.9
Dillingham Boulevard at Kapālama Stream												
AM	32	104	34	20.2	32	106	32.3	14.4	30	100	31.3	14.2
OP	10	20	34	34	13	21	33.4	33	11	18	33	32.4
PM	101	73	25.4	33.8	90	77	21.2	25.6	82	64	21.2	25.5
H-1 Freeway at Kapālama Stream												
AM	91	97	64.8	64.4	82	101	52.6	31.5	82	83	50.3	49.9
OP	83	65	65	65	70	64	57.8	59.1	71	68	57.4	58.5
PM	92	89	64.8	64.8	95	86	40.8	50.1	97	80	30.9	51.5
North King Street at Kapālama Stream												
AM	22	109	35	12.3	24	100	33.8	17.4	31	82	32.7	22.8
OP	10	19	35	35	13	21	34.4	33.9	13	18	34	33.7
PM	94	46	34	34.9	89	60	22.3	30.1	86	60	21.8	28.4

OP = off-peak, WB = westbound, EB = eastbound (Note: abbreviations apply to this table only)

3.1.6 Review of Transit Travel Time Functions

The transit travel time functions were estimated based on the base year 1996 transit network schedule times between time points. The estimated times were gathered from the calculated transit link times (from the base year 1996 model) and converted to the equivalent transit segments defined by the observed data time points. Segments were classified by facility type, though in many cases a segment included more than one facility type. This analysis was done in December 2002. The transit travel time functions used in the O‘ahuMPO model are simply factors that are applied to the congested highway travel times to represent transit times. For freeways, expressways, and ramps, these factors are set to 1 since no stops are generally made along these facilities.

Note also that a 0.17-minute (about 10 seconds) dwell time penalty was applied to each transit link to represent time spent serving passenger access and egress at stops. Since the schedule time is being used as the basis for comparison, this dwell time is included in the comparisons, but only the actual link speed is adjusted by the transit time factor. Table 3-32 shows the computed transit travel time factors applied by facility type during transit path building. Figure 3-20 and Figure 3-21 show the initial observed and estimated transit segment time comparisons by facility type. While there is much scatter to the data (average r-square of 0.40, correlation of 0.65) the overall average speeds were modeled as well as possible given the single multiplicative transit travel time factor.

The factors shown in Table 3-32 were updated to reflect the use of the conical VDFs rather than the Akçelik curves used originally. These factors typically reflect a 40 to 80 increase in transit travel time over the average speed of traffic due to stops, wait time, and vehicle performance characteristics, including speed acceleration and deceleration rates.

Table 3-32: Transit Link Time Factors

Facility	Peak (based on AM Peak)	Off-peak
Freeways and expressways	1.0	1.0
Ramps	1.0	1.0
Arterial Class I	1.53	1.59
Arterial Class II	1.48	1.77
Arterial Class III	2.38	1.60
Collector Class I	1.46	1.82
Collector Class II	2.75	2.16
Local streets	1.10	1.56

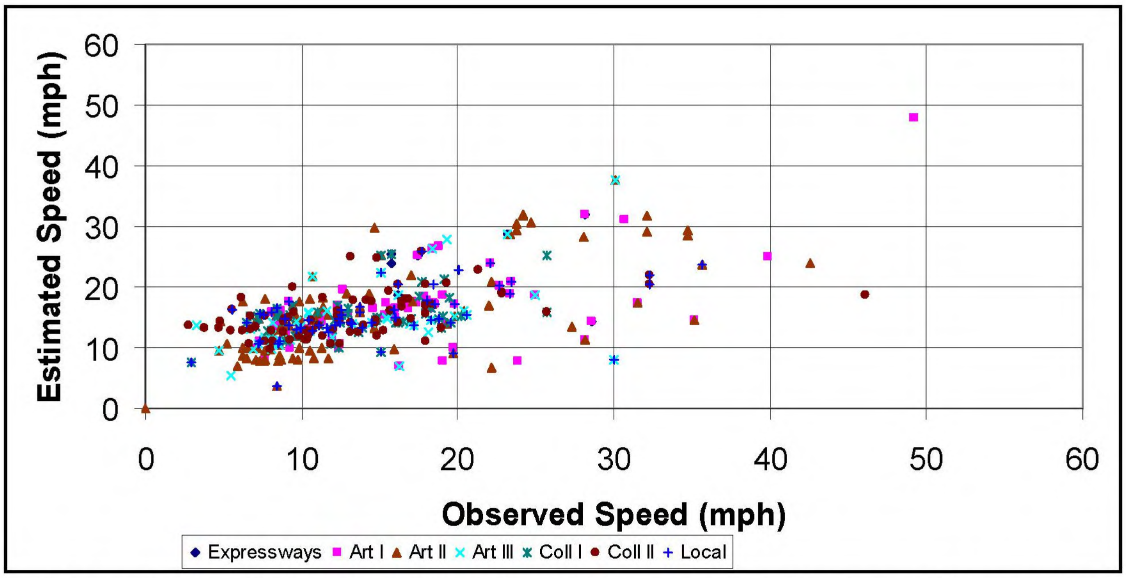


Figure 3-20: O'ahuMPO 1995 Transit Segment Peak Speed Comparison with Conical Volume Delay Functions

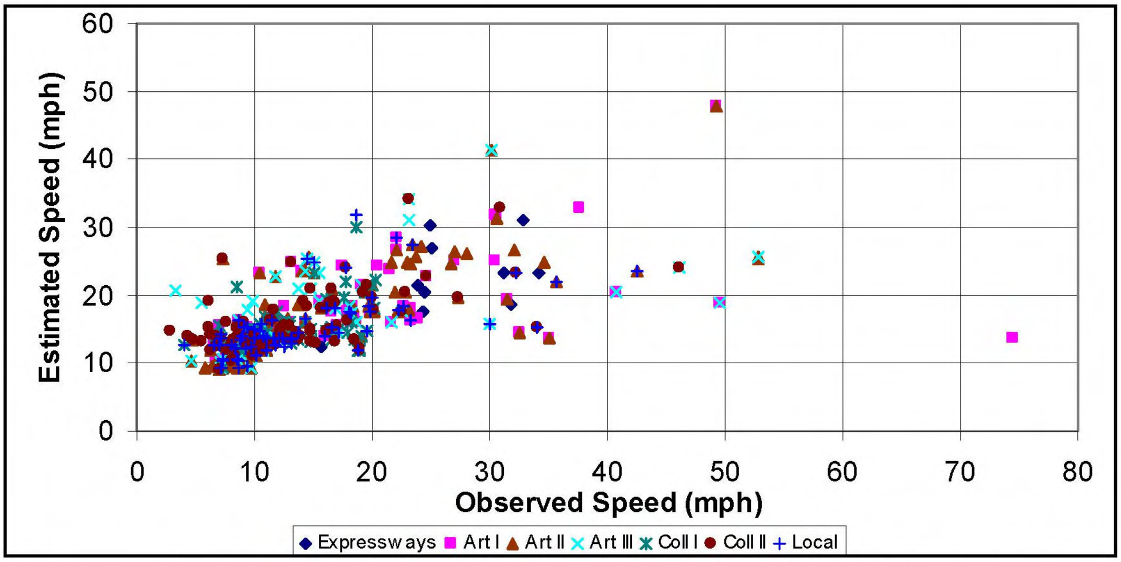


Figure 3-21: O'ahuMPO 1995 Transit Segment Off-peak Speed Comparison with Conical Volume Delay Functions

3.1.7 Examination of Variations in Speed Table/Free Flow Speed Assumptions

Testing of the O'ahuMPO travel demand model revealed potential issues with selected free-flow highway speeds coded in the model. The issue revealed itself in evaluations of transit paths between Leeward/Central O'ahu and Downtown Honolulu. During one of these evaluations, transit passengers were found to ride a generic fixed guideway mode to a station located just short of Downtown, then transferred to local bus mode for completion of the trip into Downtown Honolulu. This yielded the shortest travel time for the traveler. When speeds were checked, it was found that the local buses were traveling at significantly higher speeds than those observed today due to relatively high modeled speeds on the arterial/collector roadways within the Downtown/Urban Core.

The use of Akçelik VDFs contributed to this issue, but even the substitution of the conical VDFs did not eliminate the unrealistically high speeds of the local buses in the urban core areas. Unless these roadway links were significantly congested, the VDFs did not reduce speeds to observed levels. It is believed that these relatively high roadway speeds result because the travel demand model codes relatively high free-flow speeds for selected roadway links within the Downtown/Urban Core area.

To test this hypothesis, speed surveys were conducted over two weekdays on major roadway facilities within the Downtown/Urban Core area. It was found that the actual average vehicular speeds (including stops for traffic signals) during the midday off-peak time period were between 5 and 15 mph less than the coded free flow speed. Additionally, it was found that the modeled speeds on these facilities were faster than the observed speeds for the AM peak, midday off peak, and PM peak time periods.

As a result, a recommendation was made to reduce the coded free flow speed in the O‘ahuMPO travel demand model for selected facility types in the Downtown/Urban Core area of Honolulu.

The adjustments to the coded free-flow highway speeds are located in the part of the study corridor that extends from Palama Street on the west side, through Downtown, to approximately the edge of Kaimukī/Kapahulu on the east side. This area includes Palama, Chinatown, Downtown, Kaka‘ako, Ala Moana, Waikīkī, Makiki, McCully, and Mō‘ili‘ili.

Figure 3-22 illustrates the roadways designated as Area Types 1 (CBD), 2 (core commercial), and 3 (core residential). It is the non-freeway roadways in these area types that are proposed for reduction in coded free-flow speed.

The non-freeway roadways coded in red, dark blue, and cyan on Figure 3-22 are proposed to have their free-flow speeds reduced. The colors represent the following area types:

- Red Area Type 1 Central Business District
- Dark Blue Area Type 2 Core Commercial
- Cyan Area Type 3 Core Residential

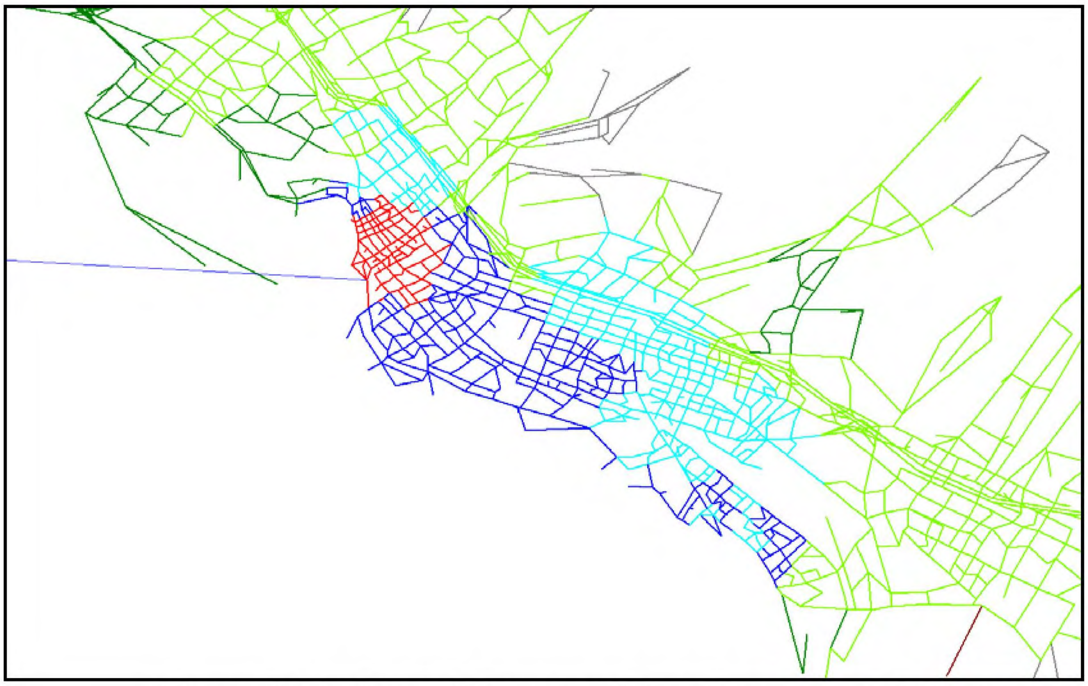


Figure 3-22: Area of Proposed Free Flow Speed Adjustments

Traffic flow in this area is strongly regulated by traffic signals. Even in low traffic demand time periods, the at-grade intersections on the arterial and collector roadway system constrain the average speeds that can be achieved by vehicles.

Observations of existing highway speeds were conducted on Wednesday, January 25, and Thursday, January 26, 2006. Observations were conducted using the floating car method with observers driving pre-defined routes and recording travel times between checkpoints. The travel times were used with distances between checkpoints to calculate average vehicle speeds. These average speeds include time spent waiting at traffic signals.

Two arterial roadway corridors were sampled:

- South King Street/Beretania Street
- Kapiʻolani Boulevard

The roadway corridors traversed the area between Downtown Honolulu and the western edge of Kaimukī.

South King Street/South Beretania Street Corridor

Figure 3-23 and Figure 3-24 illustrate speeds on the South King Street/South Beretania Street corridor in the eastbound and westbound directions, respectively. These two one-way streets operate as a couplet with South King Street serving the eastbound traffic and South Beretania Street serving the westbound traffic. Three time periods were sampled: AM commuter peak, PM commuter peak, and midday off-peak.

The graphs show both observed and modeled speeds for the three time periods. As shown, the observed speeds are significantly lower than the modeled speeds. The graphs also illustrate the coded free-flow speed used by the travel demand model. With a few exceptions, the modeled speeds are only slightly less than the coded free-flow speed, even using the revised conical VDFs. The observed speeds are between 5 and 15 mph less than the modeled speeds.

Additionally, it was found that average vehicle speeds during the midday off-peak time period were also less than the coded free flow speeds.

Based on these observations and results, it is believed that 25 mph would be a more realistic free flow speed for these area types.

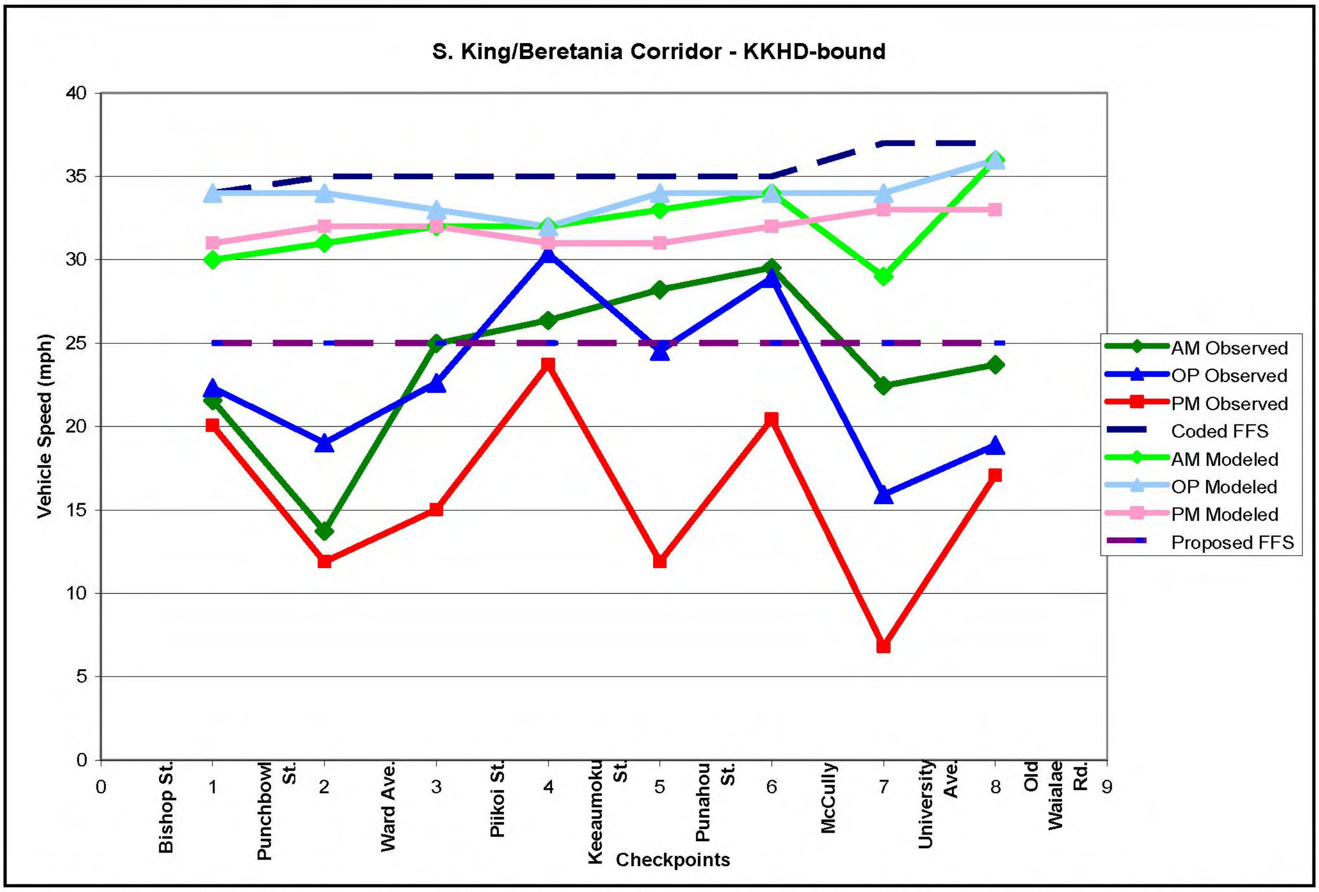


Figure 3-23: Eastbound Speeds in South King Street/South Beretania Street Corridor

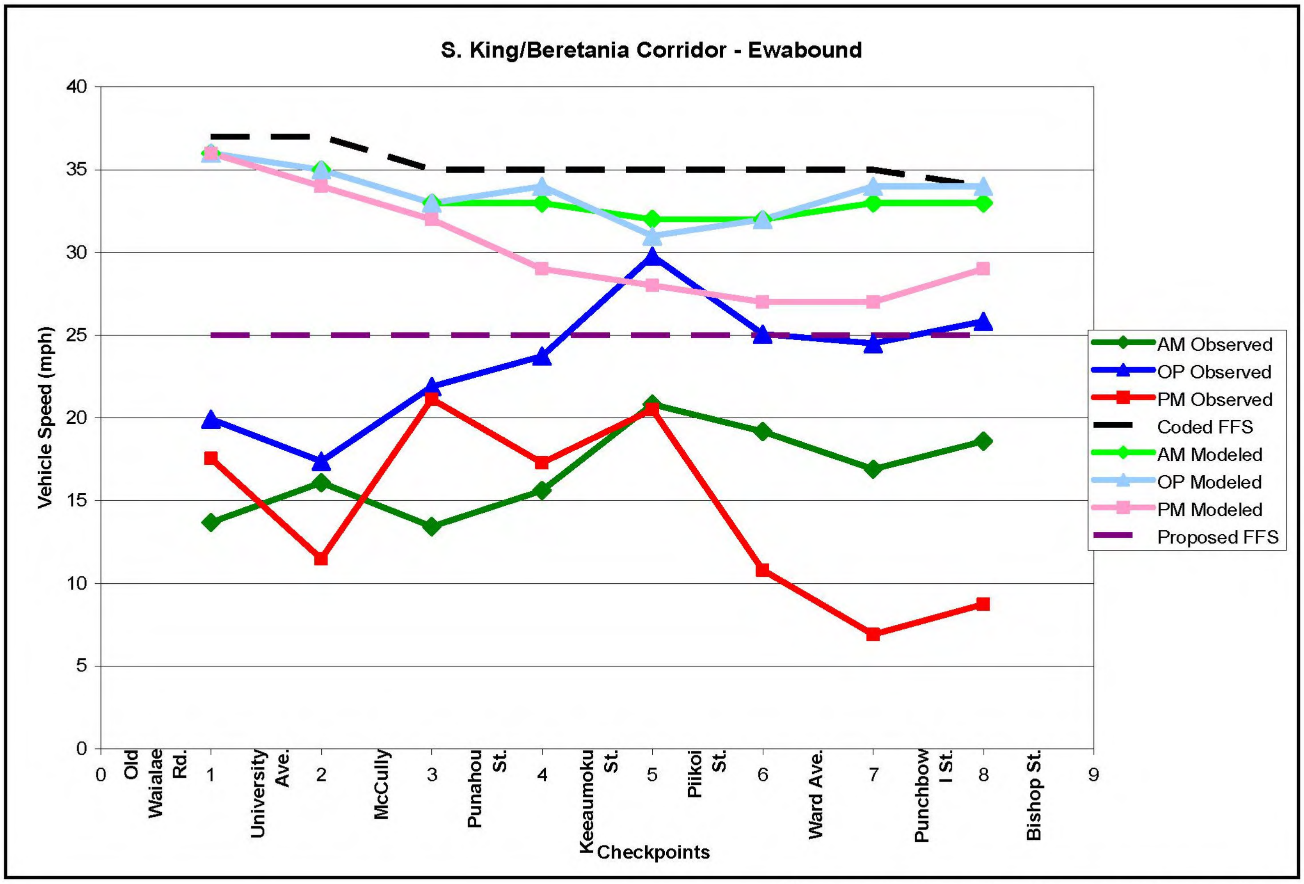


Figure 3-24: Westbound Speeds in South King Street/South Beretania Street Corridor

Kapi‘olani Boulevard Corridor

Figure 3-25 and Figure 3-26 illustrate speeds on the Kapi‘olani Boulevard corridor in the eastbound and westbound directions, respectively. Three time periods were sampled—AM commuter peak, PM commuter peak, and midday off-peak.

These graphs also show that the modeled speeds are only slightly less than the coded free-flow speeds while the observed speeds are between 5 and 15 mph less than the modeled speeds.

As in the South King Street/South Beretania Street corridor, observed average vehicle speeds during the midday off-peak time period were significantly lower than the coded free flow speeds.

The results in the Kapi‘olani Boulevard corridor also supported the suggestion to set the coded free flow speeds to 25 mph.

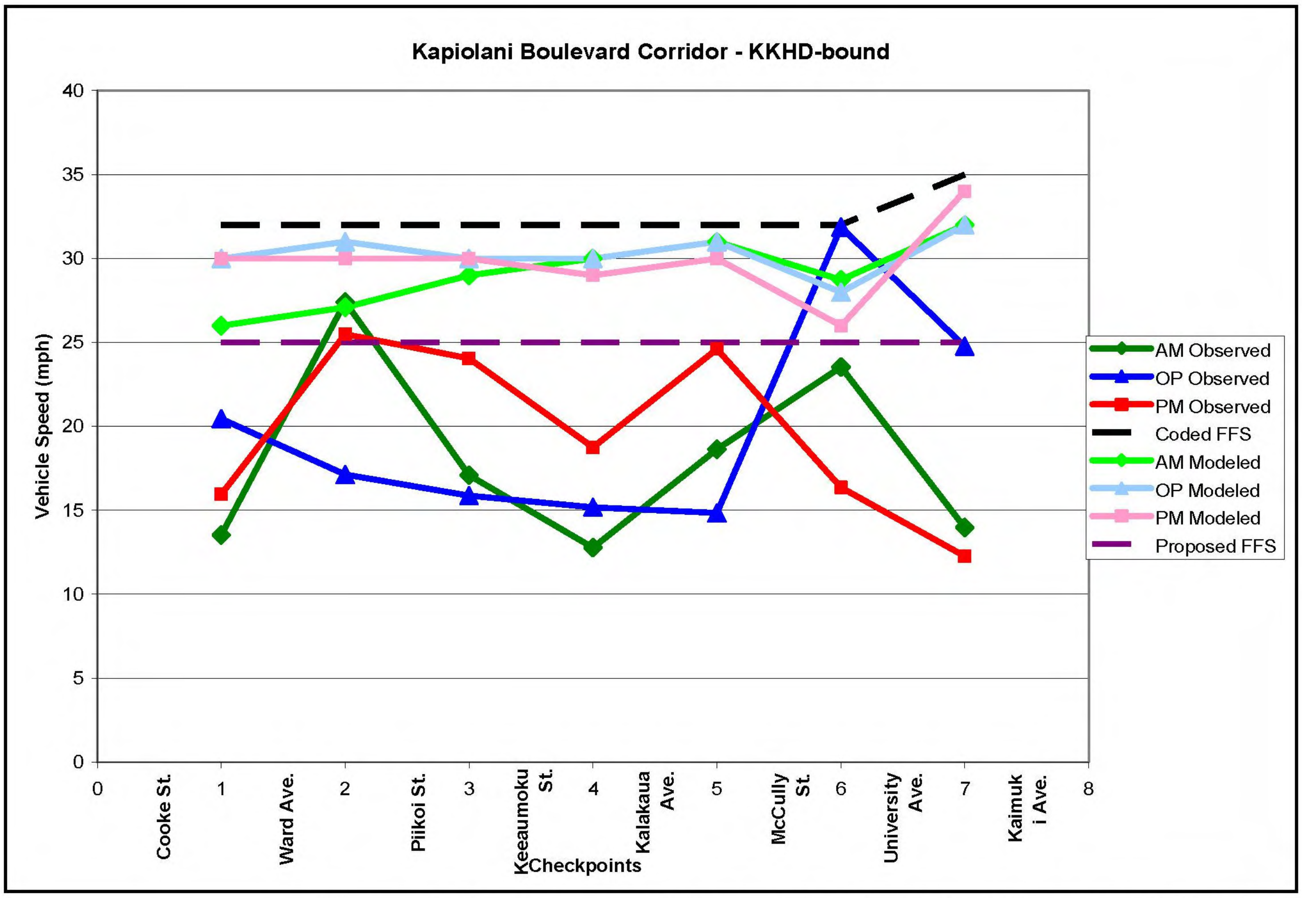


Figure 3-25: Eastbound Speeds in Kapi‘olani Boulevard Corridor

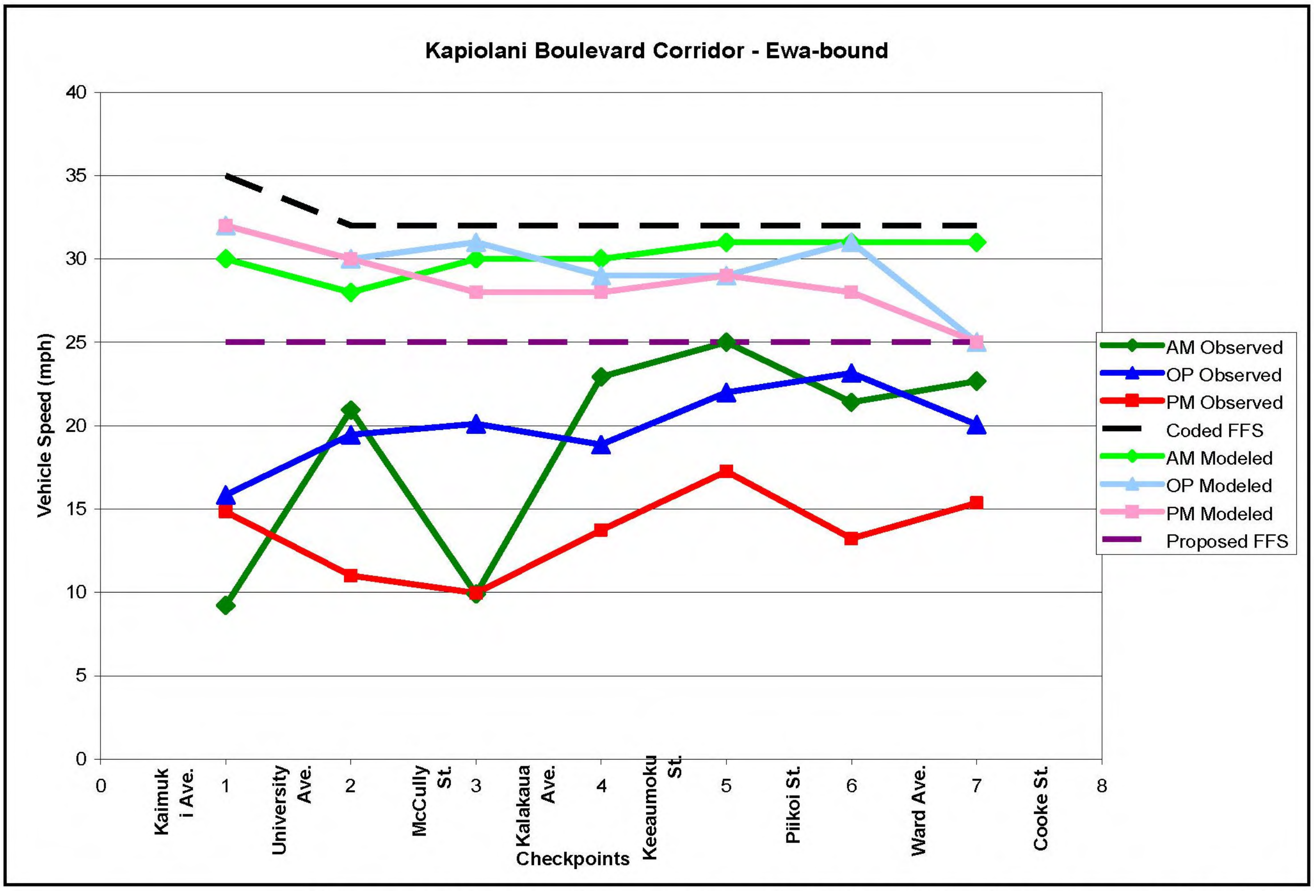


Figure 3-26: Westbound Speeds in Kapi'olani Boulevard Corridor

Based on the results of the speed surveys on the South King Street/South Beretania Street and the Kapi'olani Boulevard arterial roadway corridors, the model free flow speed table was modified to code lower speeds for selected roadway facility types for Area Types 1, 2, and 3.

Table 3-33 shows the free flow speeds coded into the O'ahuMPO model roadway links by area type and facility type.

All of the free flow speeds in the shaded area were reduced to 25 mph. Doing so will bring the speeds on these facilities more in line with the observed average travel speeds on these roadways.

Table 3-33: O'ahuMPO Travel Demand Model Free Flow Speeds

Facility Type	Area Type							
	CBD	Core Commercial	Core Residential	Urban Commercial	Urban Residential	Suburban Commercial	Suburban Residential	Rural
Freeway	60	63	63	65	65	68	68	68
Expressway	54	57	58	59	60	60	63	63
Class I arterial	34	35	35	37	37	41	45	47
Class II arterial	30	32	32	34	35	40	42	47
Class III arterial	28	30	30	32	33	37	40	47
Class I collector	26	28	28	30	30	35	39	46
Class II collector	24	26	27	28	28	33	38	45
Local street	12	17	18	19	20	25	30	32
High-speed ramp	50	50	51	51	52	52	55	57
Low-speed ramp	25	30	30	30	30	35	35	37
Centroid Connector	12	17	18	19	20	25	30	32

3.1.8 Evaluation of Parking Cost Representation and Forecasting

This section examines the parking costs used in the O'ahuMPO model, including their patterns and derivation, and a comparison with reported parking cost from home interview survey (HIS) data. Since there is no parking cost model, parking costs must be provided exogenously to the model and, as such, they have not been adjusted from the base year for future year conditions. This implicitly assumes that parking costs will keep pace with inflation over time, remaining constant in real dollars. This is a trend that has, in fact, been observed in Honolulu and elsewhere as parking cost is directly influenced by a competitive supply and demand marketplace.

Model Representation of Parking Costs

The socioeconomic file contains non-zero parking costs for CBD and other core areas, as defined by Area Types 1, 2, and 3. Elsewhere, parking costs are set to 0. Only three unique non-zero values for parking cost are used for peak and three for off-peak conditions. Table 3-34 shows the current parking costs used. Figure 3-27 shows a map of modeled parking costs by zone.

Table 3-34: Current O'ahuMPO Model Parking Costs (1995 dollars)

Area Type	Daily Peak Parking Cost	Daily Off-peak Parking Cost
Central Business District (Area Type 1)	$3.05	$ .76
Core Commercial (Area Type 2)	$1.36	$ .34
Core Residential (Area Type 3)	$ .64	$ .16

Note that the off-peak parking cost is one-quarter of the daily parking cost. This is representative of an average 2-hour off-peak parking duration versus an 8-hour parking duration for work trips which occur in the peak time period.

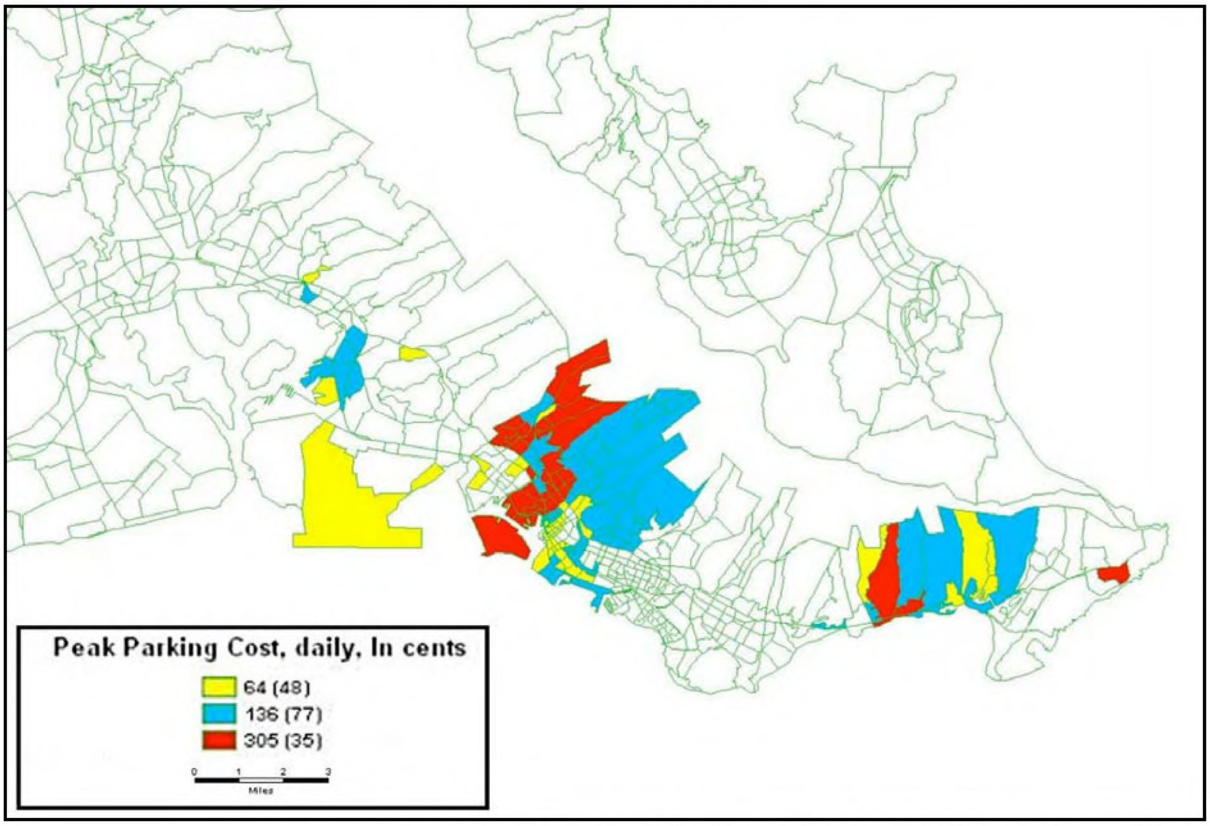


Figure 3-27: Modeled Parking Cost (Peak, Cents/Day)

Parking Cost from HIS Data

The only source of observed, out-of-pocket parking cost data is the 1995 O'ahuMPO HIS. As a part of the survey, each worker and student was asked to provide his/her usual parking costs for work and/or school (i.e., college). The question asked, "How much did you pay for parking?," and was followed by questions related to employer or school subsidies, so it was clear that the cost requested was what the traveler paid directly. This information was codified in the person data section.

Parking cost data was extracted from the HIS using the following steps:

- Identify person-records of persons that were students and/or employees and had an opportunity to park at their work or school location
- Attach to these records the household weight and geo-coded information (zone and coordinates) of the work and/or school location
- Attach area-type information based on the reported work location
- Summarize the reported weighted average parking cost by zone and by area type

Table 3-35 shows the resulting observed parking cost.

Table 3-35: HIS-based Parking Costs (1995 cost)

Area Type	Daily Peak Parking Cost	Standard Error
Central Business District (Area Type 1)	$2.86	11%
Core Commercial (Area Type 2)	$1.23	9%
Core Residential (Area Type 3)	$ .80	25%

The observed data generally supports the 1995 modeled parking costs. Existing and future parking costs may be forecast by assuming no change in the real cost of parking, which has been observed in several other cities, due to the market-based nature of parking costs. For Honolulu, an effort was made to evaluate the change in retail parking costs over the past 10 years to determine if the real cost of parking has changed and what this might indicate for future year parking costs in the model. However, no data for this analysis was available.

Since the parking cost is an independent, exogenous input, changes in area type do not affect the parking cost. Since it appears that the parking cost was closely tied to area type in its development, it may be advisable to update the parking cost as densities and, therefore, area types change in the future.

Note that outside of these three area types, parking is free in the model. In some areas, such as Waikīkī, parking may not be available at any price for some markets, such as low-income workers. Therefore, a question has arisen regarding whether a parking shadow price mechanism or other type of drive-to-work penalty should be implemented in the model to accommodate this influence.

3.1.9 Year 2000 Census Transportation Planning Package Person Trip Matrix Comparisons

The 2000 CTPP journey-to-work (JTW) trips were compared with the 2000 year model run journey-to-work trips to see how well the district-to-district movements match.

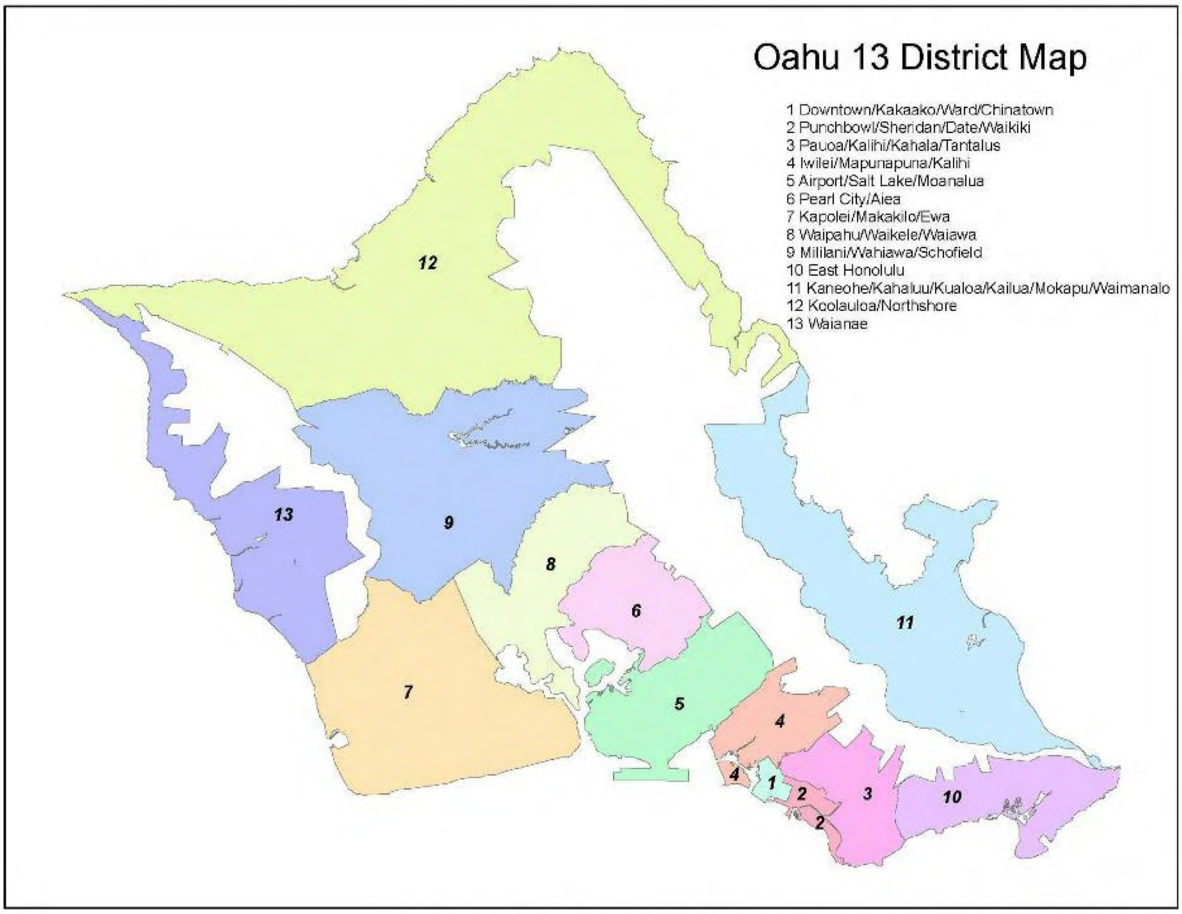


Figure 3-28: O'ahu Census Transportation Planning Package 13 District Map

Figure 3-29 below compares CTPP and 2000 model year run journey-to-work person trips to the work place district. The model is consistent with CTPP in terms of predicting the overall number of person trips to the different work districts.

Figure 3-30 compares the journey-to-work person trips from the home location's district. Again, the model reflects similar proportions to the CTPP data.

Figure 3-29: Journey-to-Work Person Trips to Work District

Figure 3-30: Journey-to-Work Person Trips from Home District

Figure 3-31 through Figure 3-38 display the journey-to-work trips by mode and either from the home district or to the work district. These figures show that the model not only is producing and attracting overall person trips correctly (as shown in Figure 3-31 and Figure 3-32) but also accurately reflecting movements by mode (Figure 3-33 through Figure 3-38).

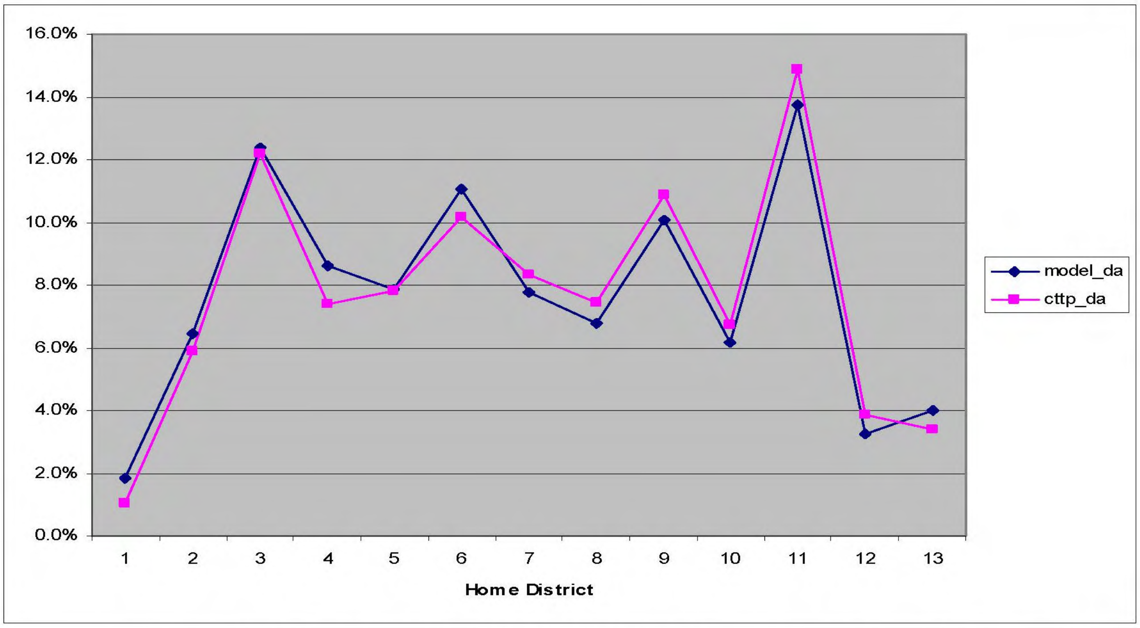


Figure 3-31: Journey-to-Work Drive Alone Trips from Home District

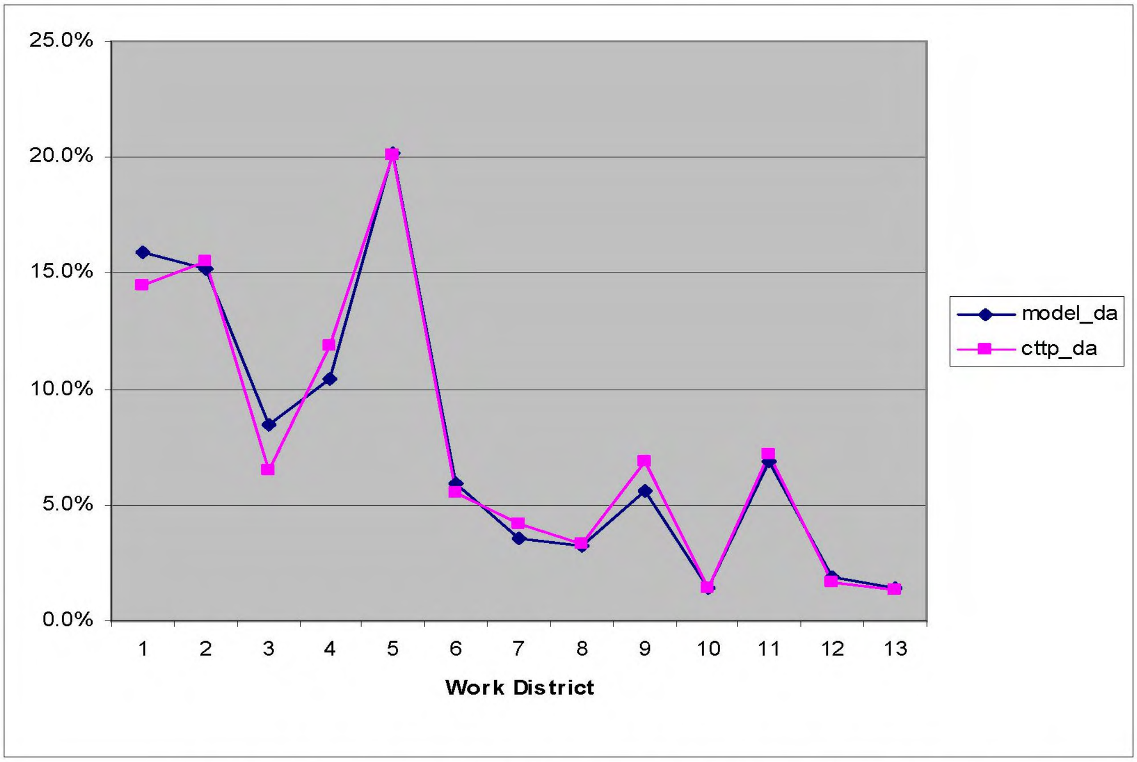


Figure 3-32: Journey-to-Work Drive Alone Trips to Work District

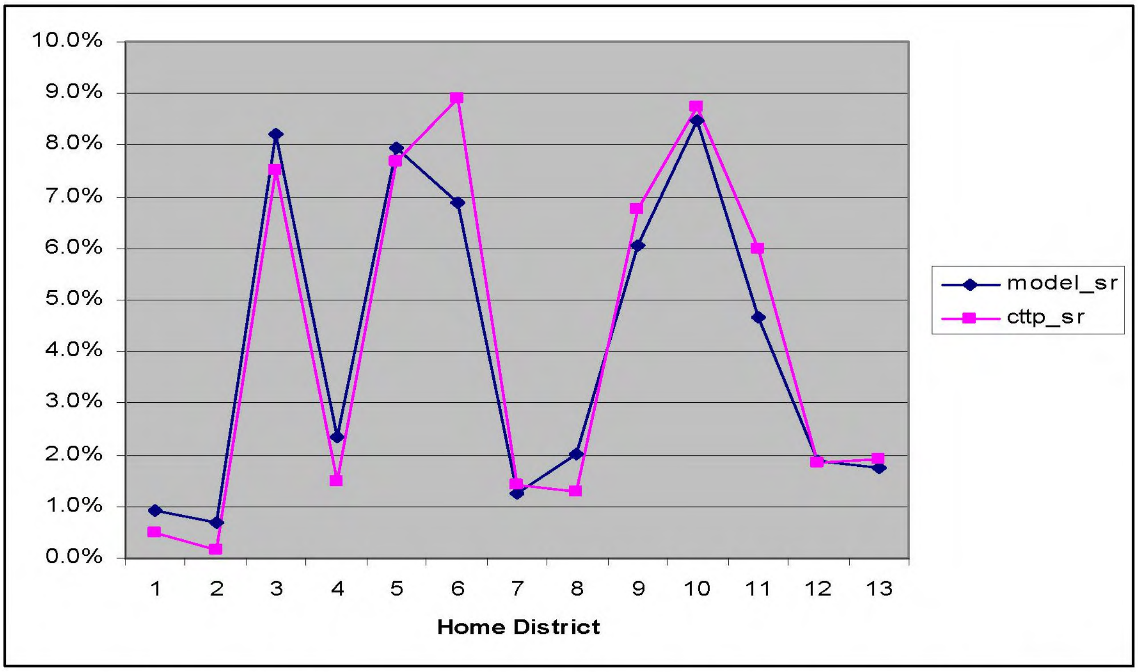


Figure 3-33: Journey-to-Work Shared Ride Trips from Home District

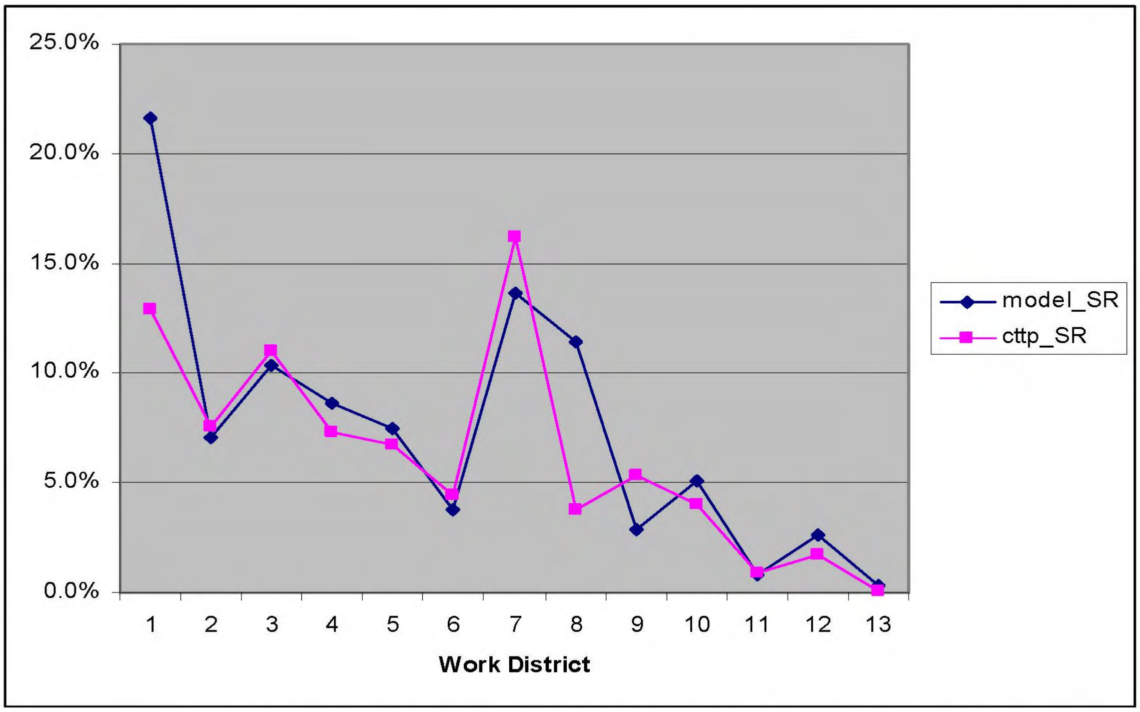


Figure 3-34: Journey-to-Work Shared Ride Trips to Work District

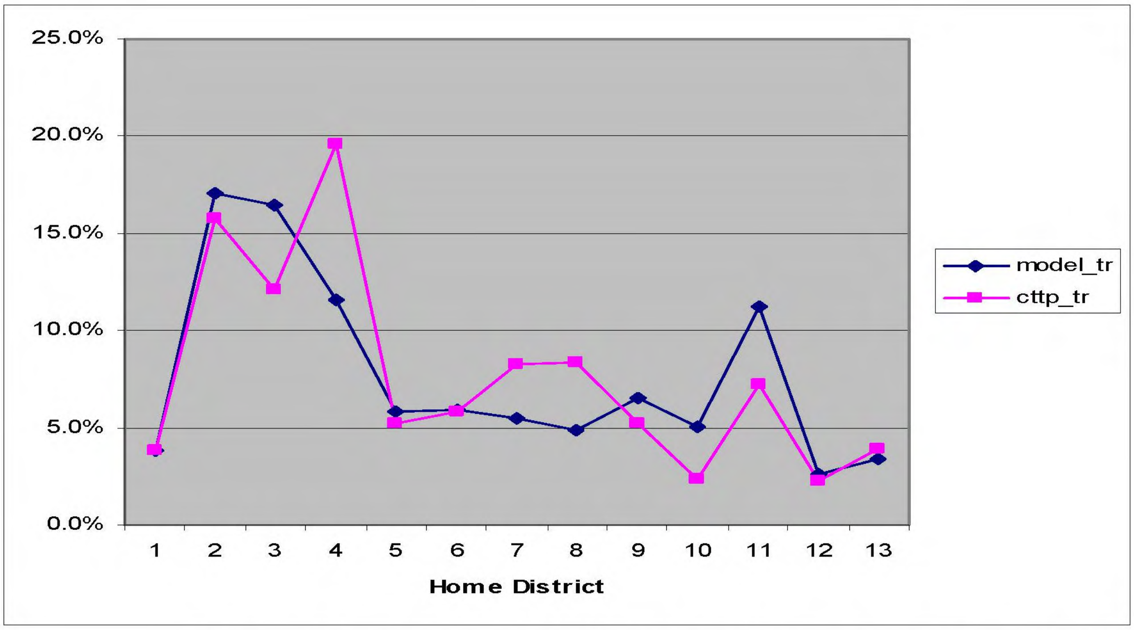


Figure 3-35: Journey-to-Work Transit Trips from Home District

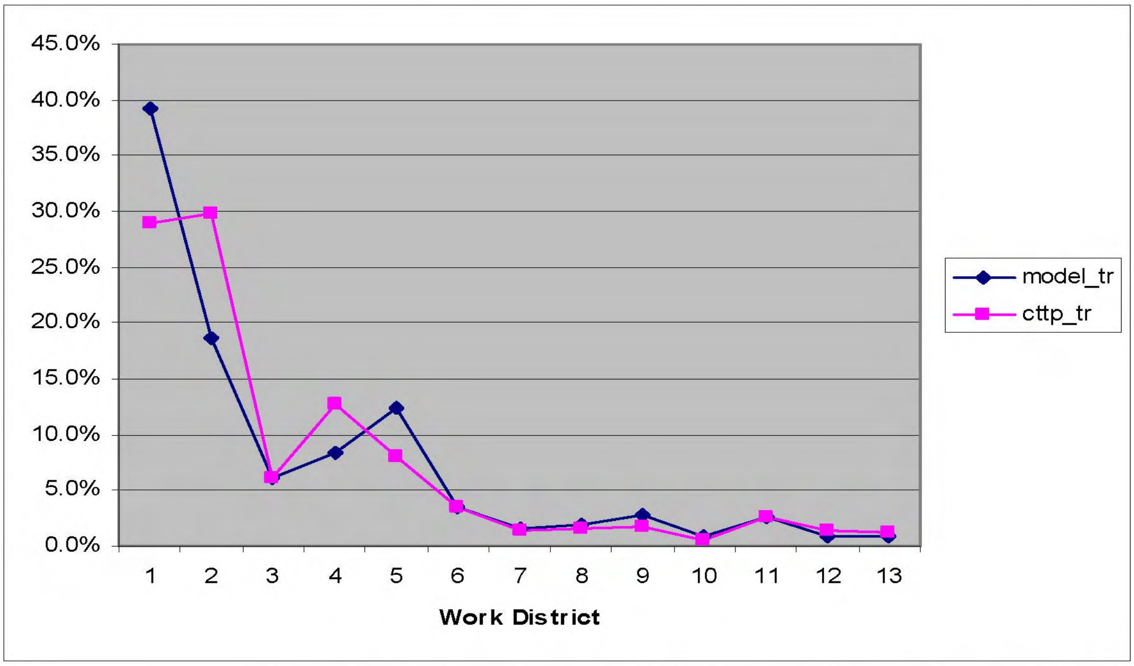


Figure 3-36: Journey-to-Work Transit Trips to Work District

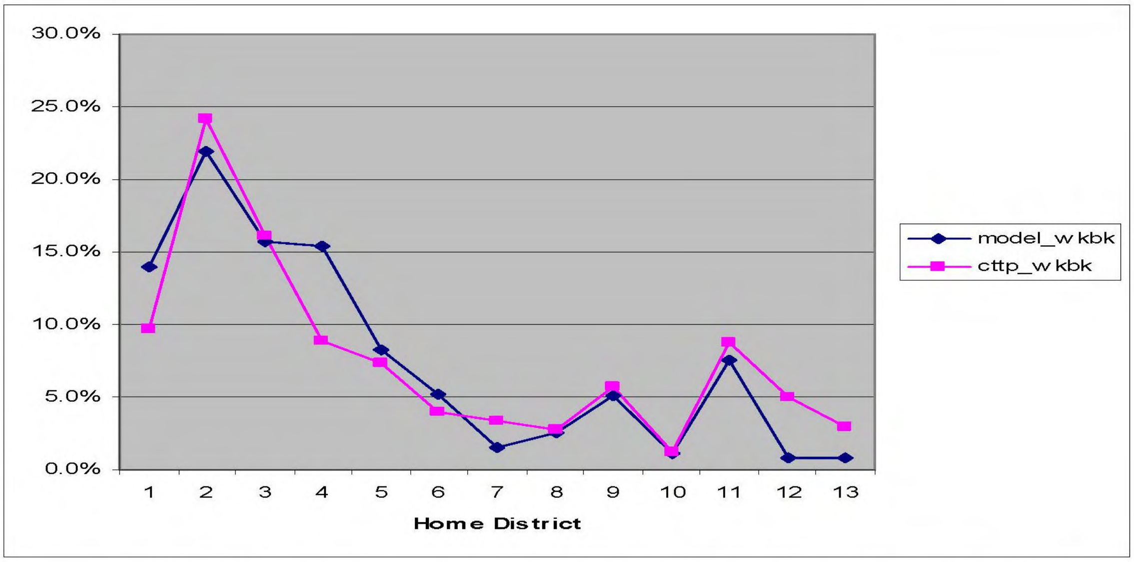


Figure 3-37: Journey-to-Work Auxiliary (Bike/Walk) Trips from Home District

Figure 3-38: Journey-to-Work Auxiliary (Bike/Walk) Trips to Work District

Figure 3-39 is a scatter plot of the 2000 model journey-to-work trips versus the 2000 CTPP journey-to-work trips. The 95 percent correlation coefficient shows that the predicted (model) district-to-district movements follow the observed district-to-district movements (CTPP data) quite well.

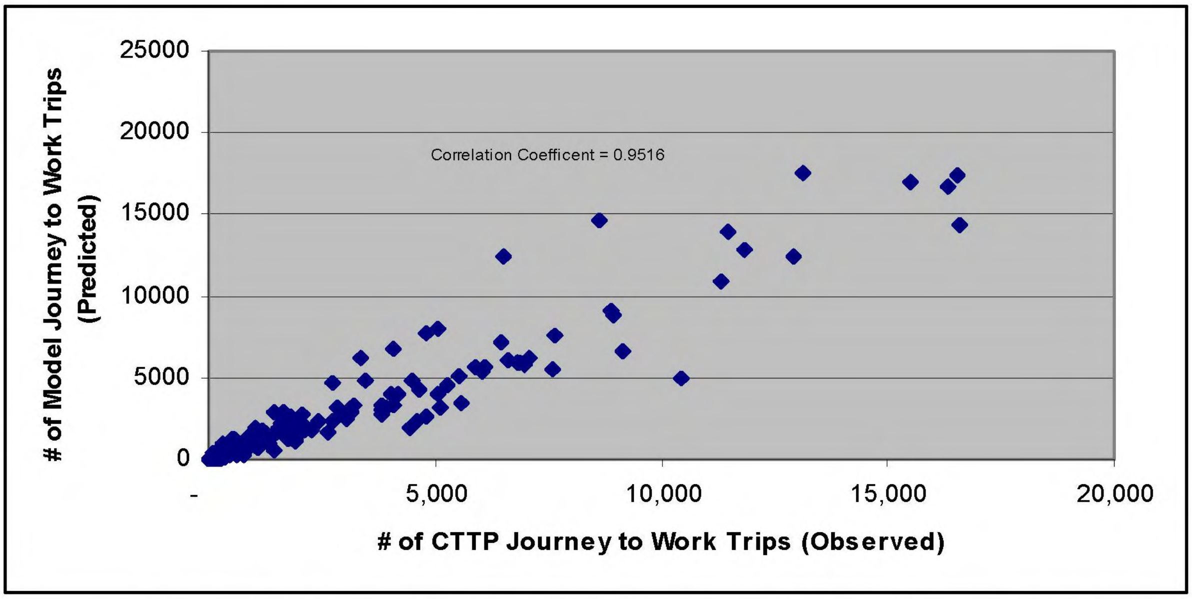


Figure 3-39: Correlation Plot of Journey-to-Work Trips—Model versus Census Transportation Planning Package

Table 3-36 shows the district-to-district flows for journey-to-work person trips from the year 2000 O'ahuMPO model. Table 3-37 shows the same information from 2000 CTPP but factored and normalized to the same total person trips from the 2000 O'ahuMPO model. Table 3-38 shows the percent difference between Table 3-36 and Table 3-37.

Table 3-36: Journey-to-work Person Trips—2000 Year O‘ahuMPO Model

Home District	Work District													
	1	2	3	4	5	6	7	8	9	10	11	12	13	*Total*
1	6,807	2,801	982	1,865	1,255	211	41	45	59	69	189	15	3	***14,342***
2	12,431	17,020	6,159	3,264	2,962	505	108	136	154	396	464	45	18	***43,662***
3	17,605	17,361	12,491	6,075	5,658	966	213	278	348	893	957	131	61	***63,037***
4	14,603	5,017	2,956	10,906	7,987	1,237	228	312	305	255	1,295	80	33	***45,214***
5	4,851	2,620	1,847	4,038	16,666	2,617	369	1,250	569	174	1,183	116	44	***36,344***
6	5,951	4,032	2,279	5,046	14,014	7,540	1,258	2,842	1,931	252	1,695	317	140	***47,297***
7	3,407	4,259	1,408	2,350	6,598	2,424	7,179	2,350	1,932	201	1,086	374	1,225	***34,793***
8	3,213	7,679	1,101	1,919	5,755	2,773	1,721	3,296	1,836	104	732	175	133	***30,437***
9	4,542	3,152	1,866	3,095	8,868	3,113	1,697	1,754	14,315	261	1,437	966	235	***45,301***
10	5,996	5,695	4,900	2,362	2,861	561	219	189	394	2,828	1,004	200	81	***27,290***
11	12,795	5,586	3,254	6,233	9,128	2,938	673	870	1,058	572	19,237	534	169	***63,047***
12	1,746	1,303	778	866	1,922	526	355	363	1,659	153	699	5,331	116	***15,817***
13	2,141	1,606	963	1,095	4,705	804	1,201	701	754	176	747	346	4,064	***19,303***
Total	***96,088***	***78,131***	***40,984***	***49,114***	***88,379***	***26,215***	***15,262***	***14,386***	***25,314***	***6,334***	***30,725***	***8,630***	***6,322***	***485,884***

Table 3-37: Factored/Normalized Journey-to-work Person Trips—2000 CTPP

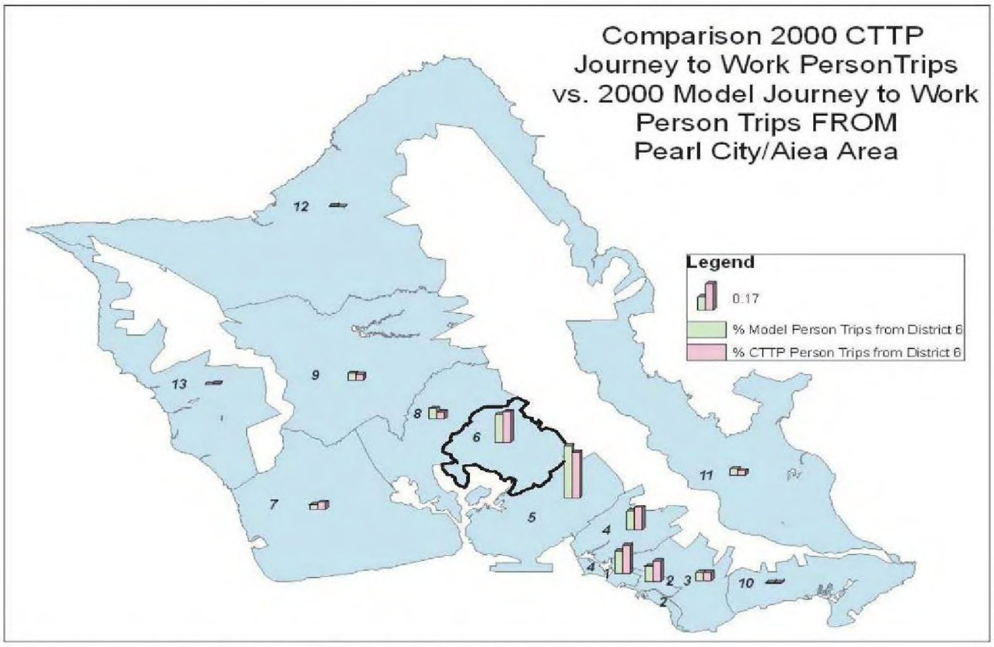
Home District	Work District													
	1	2	3	4	5	6	7	8	9	10	11	12	13	*Total*
1	4,077	2,089	551	1,013	832	222	74	65	189	29	271	19	32	***9,462***
2	6,533	15,504	3,351	3,848	3,158	555	321	333	283	489	758	167	148	***35,448***
3	13,112	16,537	12,927	6,606	5,896	1,034	628	596	636	835	1,356	224	166	***60,551***
4	8,629	10,428	3,151	11,295	5,086	1,116	765	460	422	423	1,070	347	252	***43,444***
5	4,491	4,783	1,551	4,037	16,335	1,788	504	592	1,435	133	1,099	176	87	***37,011***
6	6,869	5,051	2,042	5,531	11,474	7,665	1,733	1,659	1,559	210	1,119	163	256	***45,332***
7	5,560	4,631	1,420	4,625	9,160	3,074	6,439	2,417	1,915	141	915	172	538	***41,008***
8	5,134	4,785	1,193	4,419	6,973	3,011	1,582	4,080	2,119	244	738	241	364	***34,883***
9	5,290	3,926	1,641	3,825	8,955	2,822	1,858	2,263	16,577	154	878	551	465	***49,206***
10	6,841	6,094	3,488	2,733	3,030	548	241	185	363	3,823	650	97	52	***28,145***
11	11,836	7,587	3,224	7,067	8,867	1,463	885	782	817	806	23,593	565	102	***67,595***
12	1,188	901	391	1,120	1,642	596	474	383	2,625	93	1,099	6,070	79	***16,661***
13	1,593	1,507	314	1,904	2,720	1,053	1,917	896	552	76	314	91	4,199	***17,137***
Total	***81,152***	***83,823***	***35,243***	***58,023***	***84,128***	***24,947***	***17,421***	***14,710***	***29,494***	***7,458***	***33,861***	***8,884***	***6740***	***485,884***

Table 3-38: Comparison of Journey-to-work Person Trips—Percent Difference

Home District	Work District													
	1	2	3	4	5	6	7	8	9	10	11	12	13	***Total***
1	67%	34%	78%	84%	51%	-5%	-45%	-31%	-69%	136%	-30%	-19%	-91%	***52%***
2	90%	10%	84%	-15%	-6%	-9%	-66%	-59%	-46%	-19%	-39%	-73%	-88%	***23%***
3	34%	5%	-3%	-8%	-4%	-7%	-66%	-53%	-45%	7%	-29%	-41%	-63%	***4%***
4	69%	-52%	-6%	-3%	57%	11%	-70%	-32%	-28%	-40%	21%	-77%	-87%	***4%***
5	8%	-45%	19%	0%	2%	46%	-27%	111%	-60%	30%	8%	-34%	-49%	***-2%***
6	-13%	-20%	12%	-9%	22%	-2%	-27%	71%	24%	20%	51%	95%	-45%	***4%***
7	-39%	-8%	-1%	-49%	-28%	-21%	11%	-3%	1%	42%	19%	117%	128%	***-15%***
8	-37%	60%	-8%	-57%	-17%	-8%	9%	-19%	-13%	-57%	-1%	-27%	-63%	***-13%***
9	-14%	-20%	14%	-19%	-1%	10%	-9%	-22%	-14%	69%	64%	75%	-49%	***-8%***
10	-12%	-7%	40%	-14%	-6%	2%	-9%	2%	9%	-26%	54%	107%	56%	***-3%***
11	8%	-26%	1%	-12%	3%	101%	-24%	11%	29%	-29%	-18%	-5%	65%	***-7%***
12	47%	45%	99%	-23%	17%	-12%	-25%	-5%	-37%	64%	-36%	-12%	46%	***-5%***
13	34%	7%	206%	-42%	73%	-24%	-37%	-22%	36%	130%	138%	280%	-3%	***13%***
Total	***18%***	***-7%***	***16%***	***-15%***	***5%***	***5%***	***-12%***	***-2%***	***-14%***	***-15%***	***-9%***	***-3%***	***-6%***	***0%***

To graphically show district-to-district movements, the next few maps look at several key home district areas and track where they go to work.

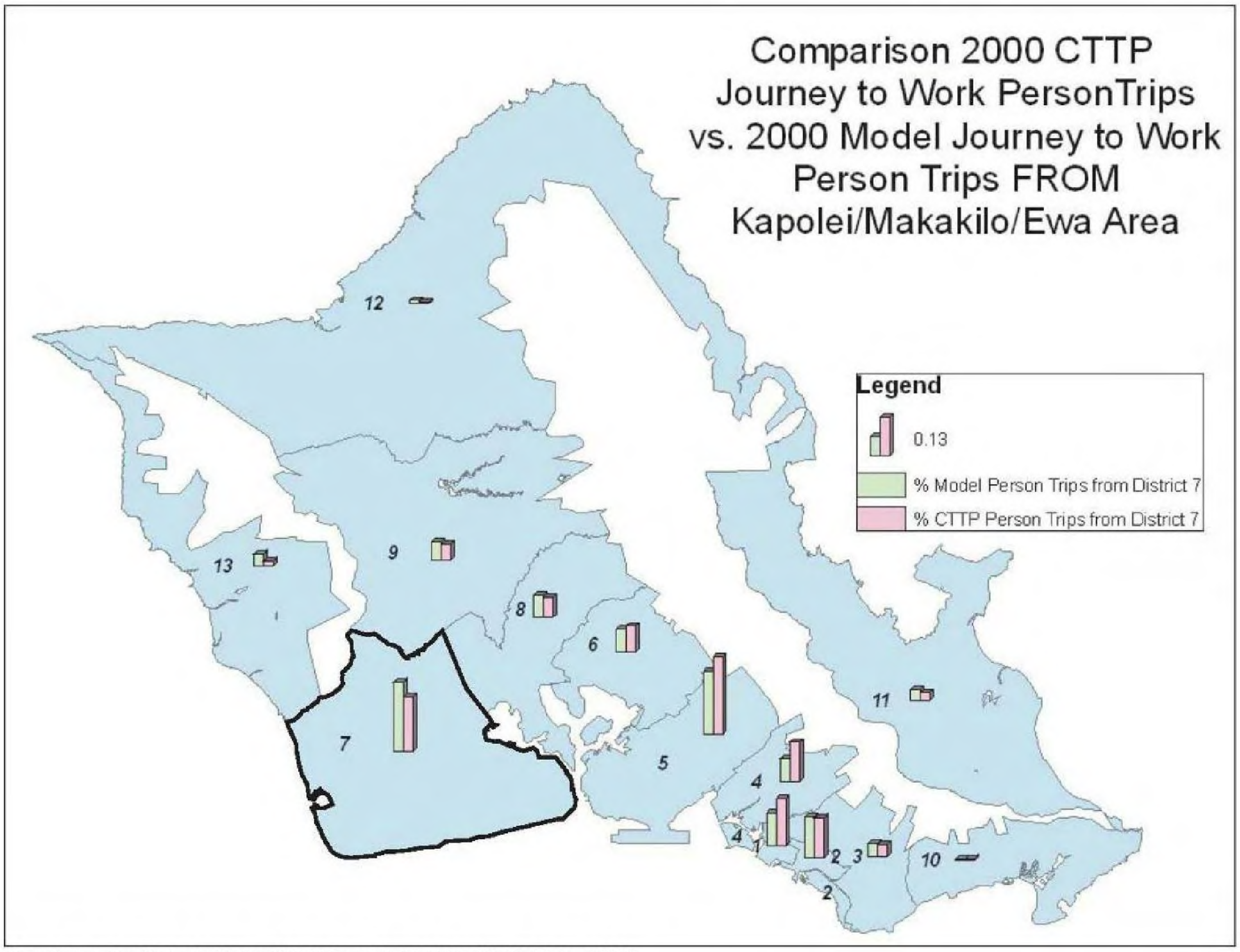
Figure 3-40 compares 2000 CTPP and 2000 modeled journey-to-work person trips of people living in the Pearl City/‘Aiea area.



Correlation Coefficient of trips ONLY from District 6 to All Districts = 97%

Figure 3-40: Pearl City/‘Aiea District 2000 Census Transportation Planning Package versus Model Person Trips to Work District

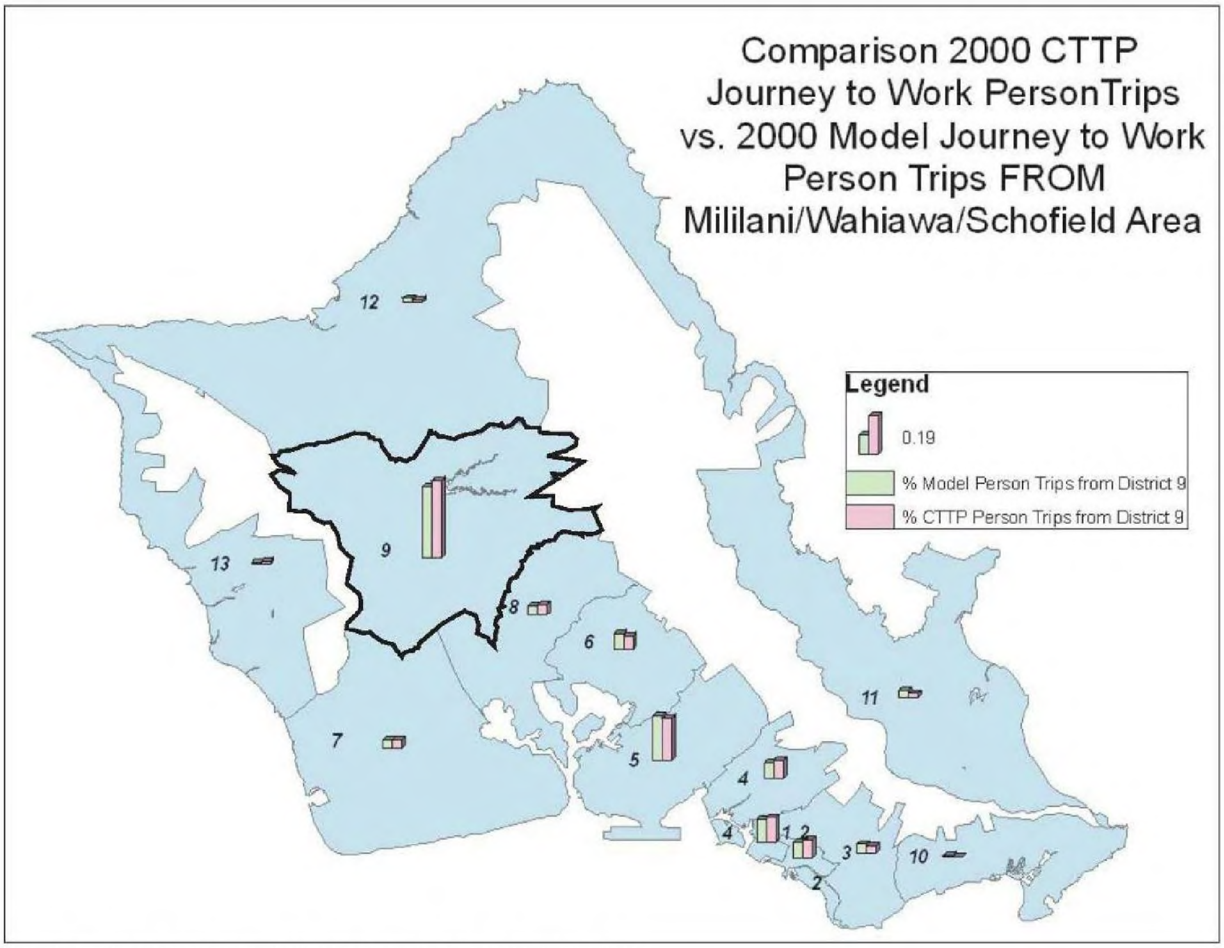
Figure 3-41 compares journey-to-work person trips from the Kapolei/Makakilo/‘Ewa area. The model seems to be attracting *slightly* more person trips to its own district (Kapolei/Makakilo/‘Ewa district) compared to CTPP.



Correlation Coefficient of trips ONLY from District 7 to All Districts = 92%

Figure 3-41: Kapolei/Makakilo/‘Ewa District 2000 Census Transportation Planning Package versus Model Person Trips to Work District

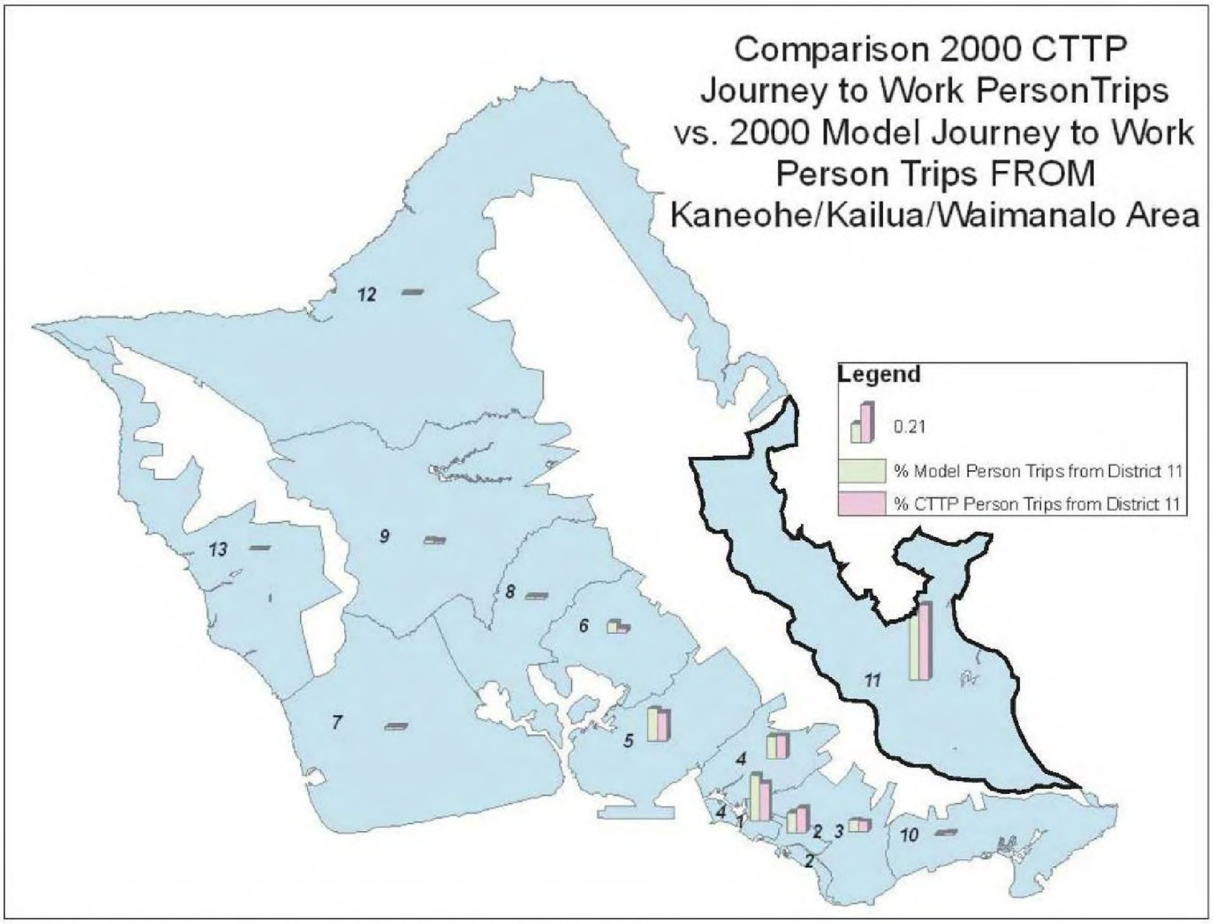
Figure 3-42 shows person trips coming from the Mililani/Wahiawā/Schofield area. The model is attracting most person trips to the Airport/Salt Lake/Moanalua district and a good proportion to its own district.



Correlation Coefficient of trips ONLY from District 9 to All Districts = 99%

Figure 3-42: Mililani/Wahiawā/Schofield District 2000 Census Transportation Planning Package versus Model Person Trips to Work District

Figure 3-43 shows person trips coming from the Kāne‘ohe/Kailua/Waimānalo area. The model is doing a relatively good job at attracting the right proportion of person trips to the work districts.



Correlation Coefficient of trips ONLY from District 11 to All Districts = 98%

Figure 3-43: Kāne‘ohe/Kailua/Waimānalo District 2000 Census Transportation Planning Package versus Model Person Trips to Work District

The comparisons above between the 2000 CTPP and 2000 model run data reveal that the model is doing a relatively good job at producing and attracting the correct proportion of person trips region-wide. Moreover, the model's distribution of trips by mode is also good. The previous figures show an excellent match between CTPP and the travel demand model of trips by mode produced to/attracted from each TAZ. The maps of CTPP and Model showing key home locations transit trips to work locations are very comparable.

3.2 Refinement of Model Purposes

3.2.1 Revision of Home-based-school (K-12) and Home-based-college Distribution

The home-based-school (K-12) (NK) purpose was identified as producing higher user benefits than anticipated by possibly adding unanticipated rail riders to the project. Detailed analysis of the home-based-school (K-12) trip generation model shows that it estimates productions by zone and then normalizes attractions to productions. The model was globally increasing attractions at each school site (designated by numbers of students in the TAZ) resulting in a significant number of fixed-guideway riders and user benefits from the ‘Ewa districts to Salt Lake (most notably) and beyond. Since the ‘Ewa side of the island did not have schools to allocate the students to, they were forced to make longer trips and produced school flow patterns that were not logical. Manual adjustments,[2] shown in Table 3-39, were made to the future number of students (primarily in the Western districts) to more reasonably reflect expected development patterns and known locations for future school sites.

Table 3-40 shows the original No Build district-to-district person trips for the home-based-school (K-12) purpose. Table 3-41 shows the No Build transit trips after the school students were manually adjusted and the difference between the original and the newly specified home-based-school (K-12) purpose is in Table 3-42. The change shows that trips were shifted into the ‘Ewa, Kapolei, Makakilo, and Waiawa districts from areas like Salt Lake, Kalihi, and Pearl City/‘Aiea. This shift in trips provides a more logical travel pattern for students on the western portion of the island by shortening the average trip length by 1.24 miles. Table 3-43 shows the overall cumulative change in student distribution while Figure 3-44 shows the change in trip length frequency. It displays a higher portion of the trips occurring in the 3- to 8-mile distance when compared to the original student distribution.

Figure 3-45 graphically shows the changes in the student distribution by TAZ as well as distance bands around the rail stop locations. This shows how the change in students by TAZ interacts by distance to the rail locations.

The manual 2030 distribution adjustments end result was a considerably more logical pattern of ridership and user benefits for O‘ahu. The change in transit person trips for the First Project Salt Lake Alternative (MOSL) is shown in Table 3-44 through Table 3-46 resulting in an 11-percent reduction in transit trips for the home-based-school (K-12) purpose. It also shows a major shift in intra-district flows for the ‘Ewa, Kapolei, Makakilo portion of the island.

The user benefit changes by district are shown in Table 3-47 through Table 3-49. Overall, the home-based-school (K-12) benefits were reduced by 42 percent, or nearly 2,000 hours as shown in Table 3-50.

[2] Control totals were not held constant since attractions are normalized to productions.

Table 3-39: Change in Student Allocation for 2030

TAZ	Adjusted 2030 K-12 Total	Original 2030 K-12 Total	Difference
373	2515	3067	-552
366	2478	3023	-545
386	2325	2836	-511
361	2067	2521	-454
389	1854	2264	-410
365	1032	1258	-226
387	984	1199	-215
385	945	1154	-209
370	875	1068	-193
390	786	959	-173
360	442	539	-97
143	798	570	228
574	924	681	243
246	1176	818	358
763	792	400	392
170	1378	976	402
601	791	383	408
604	791	383	408
145	1439	1028	411
195	1599	1142	457
567	1056	568	488
464	516	0	516
466	516	0	516
474	516	0	516
477	516	0	516
478	516	0	516
479	516	0	516
546	526	0	526
549	526	0	526

TAZ	Adjusted 2030 K-12 Total	Original 2030 K-12 Total	Difference
600	526	0	526
764	526	0	526
564	1132	568	564
565	578	0	578
613	585	0	585
615	585	0	585
607	630	0	630
608	630	0	630
168	2230	1593	637
595	791	0	791
599	791	0	791
596	792	0	792
571	925	0	925
572	925	0	925
614	1170	0	1170
472	1190	0	1190
199	4213	3009	1204
597	3120	766	2354
555	2406	0	2406
475	2947	0	2947
545	3961	0	3961

Table 3-40: Original Home-based-school (K-12) No Build Person Trips

		Downtown	Kaka‘ako	Mō‘ili‘ili–Ala Moana	Waikīkī	Kaimukī–Wai‘alae	Palama–Liliha	Kalihi–Iwilei	Airport–Pearl Harbor	Salt Lake–Āliamanu	Pearl City–‘Aiea	‘Ewa	Kapolei	Makakilo	Waipahu–Waikele	Waiawa	Mililani	Wahiawa	East Honolulu	Kaneohe	Kailua	Ko‘olau Loa	North Shore	Wai‘anae	Makiki–Mānoa	UH Mānoa	Ala Moana Center	***Total***
1	Downtown	423	347	241	5	88	1962	634	32	99	16	0	0	0	0	0	0	0	37	14	18	0	0	0	498	16	0	***4430***
2	Kaka‘ako	300	933	819	23	262	992	282	15	52	10	0	0	0	0	0	0	0	61	6	15	2	0	0	1179	47	0	***4998***
3	Mō‘ili‘ili–Ala Moana	157	443	2685	107	1344	610	152	13	39	8	0	0	0	0	0	1	0	231	7	11	0	0	0	2610	250	0	***8668***
4	Waikīkī	34	138	831	277	773	138	38	3	8	5	0	0	0	0	0	0	0	84	2	2	1	0	0	643	69	0	***3046***
5	Kaimukī–Wai‘alae	58	132	1831	454	8181	457	115	23	46	13	1	0	0	1	0	2	0	1261	8	12	3	2	0	1639	420	0	***14659***
6	Palama–Liliha	301	145	129	1	77	12195	3822	245	900	159	0	0	0	7	0	1	1	29	150	82	6	0	0	477	18	0	***18745***
7	Kalihi–Iwilei	246	209	99	3	51	3877	3333	201	728	104	0	0	0	7	0	0	1	22	47	22	0	1	0	266	7	0	***9224***
8	Airport–Pearl Harbor	3	4	2	1	4	76	41	2070	915	238	0	0	0	4	0	3	2	0	9	8	0	1	1	11	1	0	***3394***
9	Salt Lake–Āliamanu	22	23	24	3	26	697	379	1358	11010	1077	1	0	0	32	1	5	6	10	62	49	11	2	2	63	11	0	***14874***
10	Pearl City–‘Aiea	25	42	67	10	100	364	335	864	2231	14512	19	2	5	1237	70	182	87	41	103	110	86	16	53	158	97	0	***20816***
11	‘Ewa	115	265	498	70	747	1546	378	557	891	2454	12259	836	171	1083	30	188	197	347	219	409	622	106	754	1104	746	0	***26592***
12	Kapolei	64	149	284	39	425	883	215	316	509	1369	1762	2032	645	444	13	92	99	195	125	233	352	58	2064	625	421	0	***13413***
13	Makakilo	45	100	195	29	288	599	145	216	345	870	191	193	1076	180	6	40	55	133	85	158	241	39	1025	426	290	0	***6970***
14	Waipahu–Waikele	74	165	317	44	474	968	241	367	591	1349	846	116	86	8422	625	1423	652	220	142	256	391	112	402	704	466	0	***19453***
15	Waiawa	32	74	150	21	218	461	108	183	307	1397	137	35	35	1420	869	2998	1651	102	63	118	185	123	199	324	221	0	***11431***
16	Mililani	23	61	117	18	171	358	87	128	211	274	24	2	4	364	261	9335	3585	80	46	96	145	179	162	253	171	0	***16155***
17	Wahiawa	12	25	48	6	74	151	34	55	91	59	7	0	1	60	22	1962	6752	33	22	43	64	309	141	112	74	0	***10157***
18	East Honolulu	36	78	597	61	2442	402	98	47	97	29	0	0	0	7	1	3	6	8594	35	430	41	6	18	813	187	0	***14028***
19	Kaneohe	18	24	37	27	69	657	138	77	175	57	1	0	0	10	0	3	6	23	12267	1965	139	6	11	89	34	0	***15833***
20	Kailua	18	23	34	5	43	506	53	45	73	34	0	0	1	3	0	1	5	78	1024	13906	23	1	10	69	31	0	***15986***
21	Ko‘olau Loa	2	4	9	1	11	26	6	11	15	4	1	0	0	2	0	1	1	5	20	9	4062	9	5	18	13	0	***4235***
22	North Shore	12	19	44	7	61	131	33	45	70	38	2	0	0	13	2	89	220	29	24	31	605	4110	25	91	62	0	***5763***
23	Wai‘anae	15	38	63	8	108	213	48	81	120	50	14	11	11	24	1	24	26	47	30	55	85	16	13714	145	101	0	***15048***
24	Makiki–Mānoa	201	268	1154	47	693	1266	390	19	64	13	0	0	0	1	0	0	0	177	13	20	1	0	1	4867	202	0	***9397***
25	UH Mānoa	5	9	134	10	150	35	9	2	2	0	0	0	0	0	0	0	0	28	0	0	1	0	0	185	128	0	***698***
26	Ala Moana Center	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	***0***
	Total	***2241***	***3718***	***10409***	***1277***	***16880***	***29570***	***11114***	***6973***	***19589***	***24139***	***15265***	***3227***	***2035***	***13321***	***1901***	***16353***	***13352***	***11867***	***14523***	***18058***	***7066***	***5096***	***18587***	***17369***	***4083***	***0***	***288013***

Table 3-41: 2030 No Build Home-based-school (K-12) Person Trips with Revised Number of Students Per Zone 2/19/08 Run

		Downtown	Kaka'ako	Mō'ili'ili–Ala Moana	Waikīkī	Kaimukī–Wai'alae	Palama–Liliha	Kalihi–Iwilei	Airport–Pearl Harbor	Salt Lake–Āliamanu	Pearl City–'Aiea	'Ewa	Kapolei	Makakilo	Waipahu–Waikele	Waiawa	Mililani	Wahiawa	East Honolulu	Kaneohe	Kailua	Ko'olau Loa	North Shore	Wai'anae	Makiki–Mānoa	UH Mānoa	Ala Moana Center	*Total*
1	Downtown	489	507	325	7	84	1786	548	20	55	19	4	0	0	2	0	1	0	30	6	9	3	0	0	522	13	0	***4430***
2	Kaka'ako	302	1231	968	21	226	799	209	8	31	11	0	0	0	0	0	0	0	52	6	5	1	0	1	1083	44	0	***4998***
3	Mō'ili'ili–Ala Moana	160	593	3108	97	1199	490	118	12	14	9	1	0	0	0	0	0	0	201	0	2	3	0	0	2434	227	0	***8668***
4	Waikīkī	35	178	966	257	709	111	29	5	5	3	0	0	0	1	0	0	1	66	1	1	0	0	0	609	69	0	***3046***
5	Kaimukī–Wai'alae	67	194	2232	449	7893	398	96	15	30	11	1	1	0	2	2	1	0	1153	3	5	4	0	3	1674	425	0	***14659***
6	Palama–Liliha	400	250	196	4	81	12237	3684	215	652	217	0	0	0	15	8	3	7	32	99	53	4	1	3	560	24	0	***18745***
7	Kalihi–Iwilei	324	353	156	3	56	3831	3276	164	508	142	0	0	0	9	5	2	2	23	30	15	3	1	0	308	13	0	***9224***
8	Airport–Pearl Harbor	5	9	5	0	7	92	52	2062	744	355	2	0	0	16	6	3	2	3	8	5	3	1	1	10	3	0	***3394***
9	Salt Lake–Āliamanu	45	49	51	5	35	867	479	1433	9726	1769	9	2	0	73	36	19	11	15	54	39	17	2	11	96	31	0	***14874***
10	Pearl City–'Aiea	22	45	69	6	80	274	239	603	1384	14808	110	41	29	1522	749	212	102	31	51	51	78	14	44	129	123	0	***20816***
11	'Ewa	43	125	211	21	240	447	101	121	179	1042	17193	3709	516	762	78	99	91	102	39	73	245	33	334	379	409	0	***26592***
12	Kapolei	23	62	104	13	118	224	49	69	81	523	2502	6307	1289	278	37	39	46	51	19	37	124	17	1008	192	201	0	***13413***
13	Makakilo	16	50	84	8	96	179	40	46	72	382	473	813	3409	129	22	25	27	39	15	30	96	14	595	149	161	0	***6970***
14	Waipahu–Waikele	54	159	264	29	300	563	129	161	229	885	3754	536	303	7365	1398	999	420	132	51	92	308	64	269	474	515	0	***19453***
15	Waiawa	15	39	67	8	74	139	31	45	62	672	439	140	91	1072	5281	1842	889	32	12	22	77	43	97	116	126	0	***11431***
16	Mililani	18	53	91	10	94	192	44	50	76	222	96	38	20	407	1756	9036	3187	43	16	33	102	113	123	160	175	0	***16155***
17	Wahiawa	8	23	46	6	44	92	23	28	39	49	37	9	6	80	209	2093	6762	24	6	15	51	216	126	75	90	0	***10157***
18	East Honolulu	55	131	812	65	2553	383	94	33	59	54	8	3	3	15	6	6	9	8157	24	300	57	7	20	930	244	0	***14028***
19	Kaneohe	35	60	73	56	116	971	193	75	174	138	4	4	3	21	12	5	15	34	11471	1876	224	7	25	144	97	0	***15833***
20	Kailua	40	54	73	12	77	764	74	40	71	87	2	5	0	16	4	4	7	105	954	13315	46	1	23	136	76	0	***15986***
21	Ko'olau Loa	2	5	10	1	13	22	4	6	8	8	1	1	0	3	0	2	2	4	12	4	4075	10	4	18	20	0	***4235***
22	North Shore	11	29	45	5	56	104	24	34	38	36	8	4	2	20	16	125	277	25	6	15	693	3971	34	89	96	0	***5763***
23	Wai'anae	10	38	66	5	71	135	31	33	56	54	54	92	98	35	6	27	33	30	12	26	72	11	13816	115	122	0	***15048***
24	Makiki–Mānoa	224	374	1432	44	638	1090	318	17	35	12	0	0	1	1	0	0	1	150	5	13	5	0	0	4838	199	0	***9397***
25	UH Mānoa	5	14	155	11	132	29	6	0	1	2	0	0	0	1	0	0	0	25	1	0	0	0	0	177	139	0	***698***
26	Ala Moana Center	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	***0***
	Total	***2408***	***4625***	***11609***	***1143***	***14992***	***26219***	***9891***	***5295***	***14329***	***21510***	***24698***	***11705***	***5770***	***11845***	***9631***	***14543***	***11891***	***10559***	***12901***	***16036***	***6291***	***4526***	***16537***	***15417***	***3642***	***0***	**288013**

Table 3-42: No Build Change in Home-based-school (K-12) Person Trips (Revised—Original)

		Downtown	Kaka‘ako	Mō‘ili‘ili–Ala Moana	Waikīkī	Kaimukī–Wai‘alae	Palama–Liliha	Kalihi–Iwilei	Airport–Pearl Harbor	Salt Lake–Āliamanu	Pearl City–‘Aiea	‘Ewa	Kapolei	Makakilo	Waipahu–Waikele	Waiawa	Mililani	Wahiawa	East Honolulu	Kaneohe	Kailua	Ko‘olau Loa	North Shore	Wai‘anae	Makiki–Mānoa	UH Mānoa	Ala Moana Center	*Total*
1	Downtown	66	160	84	2	(4)	(176)	(86)	(12)	(44)	3	4	0	0	2	0	1	0	(7)	(8)	(9)	3	0	0	24	(3)	0	***0***
2	Kaka‘ako	2	298	149	(2)	(36)	(193)	(73)	(7)	(21)	1	0	0	0	0	0	0	0	(9)	0	(10)	(1)	0	1	(96)	(3)	0	***0***
3	Mō‘ili‘ili–Ala Moana	3	150	423	(10)	(145)	(120)	(34)	(1)	(25)	1	1	0	0	0	0	(1)	0	(30)	(7)	(9)	3	0	0	(176)	(23)	0	***0***
4	Waikīkī	1	40	135	(20)	(64)	(27)	(9)	2	(3)	(2)	0	0	0	1	0	0	1	(18)	(1)	(1)	(1)	0	0	(34)	0	0	***0***
5	Kaimukī–Wai‘alae	9	62	401	(5)	(288)	(59)	(19)	(8)	(16)	(2)	0	1	0	1	2	(1)	0	(108)	(5)	(7)	1	(2)	3	35	5	0	***0***
6	Palama–Liliha	99	105	67	3	4	42	(138)	(30)	(248)	58	0	0	0	8	8	2	6	3	(51)	(29)	(2)	1	3	83	6	0	***0***
7	Kalihi–Iwilei	78	144	57	0	5	(46)	(57)	(37)	(220)	38	0	0	0	2	5	2	1	1	(17)	(7)	3	0	0	42	6	0	***0***
8	Airport–Pearl Harbor	2	5	3	(1)	3	16	11	(8)	(171)	117	2	0	0	12	6	0	0	3	(1)	(3)	3	0	0	(1)	2	0	***0***
9	Salt Lake–Āliamanu	23	26	27	2	9	170	100	75	(1284)	692	8	2	0	41	35	14	5	5	(8)	(10)	6	0	9	33	20	0	***0***
10	Pearl City–‘Aiea	(3)	3	2	(4)	(20)	(90)	(96)	(261)	(847)	296	91	39	24	285	679	30	15	(10)	(52)	(59)	(8)	(2)	(9)	(29)	26	0	***0***
11	‘Ewa	(72)	(140)	(287)	(49)	(507)	(1099)	(277)	(436)	(712)	(1412)	4934	2873	345	(321)	48	(89)	(106)	(245)	(180)	(336)	(377)	(73)	(420)	(725)	(337)	0	***0***
12	Kapolei	(41)	(87)	(180)	(26)	(307)	(659)	(166)	(247)	(428)	(846)	740	4275	644	(166)	24	(53)	(53)	(144)	(106)	(196)	(228)	(41)	(1056)	(433)	(220)	0	***0***
13	Makakilo	(29)	(50)	(111)	(21)	(192)	(420)	(105)	(170)	(273)	(488)	282	620	2333	(51)	16	(15)	(28)	(94)	(70)	(128)	(145)	(25)	(430)	(277)	(129)	0	***0***
14	Waipahu–Waikele	(20)	(6)	(53)	(15)	(174)	(405)	(112)	(206)	(362)	(464)	2908	420	217	(1057)	773	(424)	(232)	(88)	(91)	(164)	(83)	(48)	(133)	(230)	49	0	***0***
15	Waiawa	(17)	(35)	(83)	(13)	(144)	(322)	(77)	(138)	(245)	(725)	302	105	56	(348)	4412	(1156)	(762)	(70)	(51)	(96)	(108)	(80)	(102)	(208)	(95)	0	***0***
16	Mililani	(5)	(8)	(26)	(8)	(77)	(166)	(43)	(78)	(135)	(52)	72	36	16	43	1495	(299)	(398)	(37)	(30)	(63)	(43)	(66)	(39)	(93)	4	0	***0***
17	Wahiawa	(4)	(2)	(2)	0	(30)	(59)	(11)	(27)	(52)	(10)	30	9	5	20	187	131	10	(9)	(16)	(28)	(13)	(93)	(15)	(37)	16	0	***0***
18	East Honolulu	19	53	215	4	111	(19)	(4)	(14)	(38)	25	8	3	3	8	5	3	3	(437)	(11)	(130)	16	1	2	117	57	0	***0***
19	Kaneohe	17	36	36	29	47	314	55	(2)	(1)	81	3	4	3	11	12	2	9	11	(796)	(89)	85	1	14	55	63	0	***0***
20	Kailua	22	31	39	7	34	258	21	(5)	(2)	53	2	5	(1)	13	4	3	2	27	(70)	(591)	23	0	13	67	45	0	***0***
21	Ko‘olau Loa	0	1	1	0	2	(4)	(2)	(5)	(7)	4	0	1	0	1	0	1	1	(1)	(8)	(5)	13	1	(1)	0	7	0	***0***
22	North Shore	(1)	10	1	(2)	(5)	(27)	(9)	(11)	(32)	(2)	6	4	2	7	14	36	57	(4)	(18)	(16)	88	(139)	9	(2)	34	0	***0***
23	Wai‘anae	(5)	0	3	(3)	(37)	(78)	(17)	(48)	(64)	4	40	81	87	11	5	3	7	(17)	(18)	(29)	(13)	(5)	102	(30)	21	0	***0***
24	Makiki–Mānoa	23	106	278	(3)	(55)	(176)	(72)	(2)	(29)	(1)	0	0	1	0	0	0	1	(27)	(8)	(7)	4	0	(1)	(29)	(3)	0	***0***
25	UH Mānoa	0	5	21	1	(18)	(6)	(3)	(2)	(1)	2	0	0	0	1	0	0	0	(3)	1	0	(1)	0	0	(8)	11	0	***0***
26	Ala Moana Center	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	***0***
	Total	***167***	***907***	***1200***	***(134)***	***(1888)***	***(3351)***	***(1223)***	***(1678)***	***(5260)***	***(2629)***	***9433***	***8478***	***3735***	***(1476)***	***7730***	***(1810)***	***(1461)***	***(1308)***	***(1622)***	***(2022)***	***(775)***	***(570)***	***(2050)***	***(1952)***	***(441)***	***0***	***0***

AR00040884

Table 3-43: Change in Cumulative Home-based-school (K-12) Person Trips by Distance

Distance Increment	2030 No Build NK Person Trips Original	Original % of Total	Original Cum %	2030 No Build NK Person Trips Revised Number of Students	Revised Number of Students % of Total	Revised Number of Students Cum %
0–99	49,699	17%	17%	53,073	18%	18%
100–199	66,215	23%	40%	72,964	25%	44%
200–299	46,495	16%	56%	51,077	18%	61%
300–399	27,852	10%	66%	31,563	11%	72%
400–499	18,347	6%	72%	19,691	7%	79%
500–599	11,826	4%	77%	12,493	4%	84%
600–699	8,370	3%	79%	8,239	3%	86%
700–799	5,730	2%	81%	5,612	2%	88%
800–899	4,663	2%	83%	4,202	1%	90%
900–999	3,686	1%	84%	3,217	1%	91%
1000–1099	2,669	1%	85%	2,196	1%	92%
Ave Trip Length		Orig =	5.3592 mi		Revised=	4.1186 mi

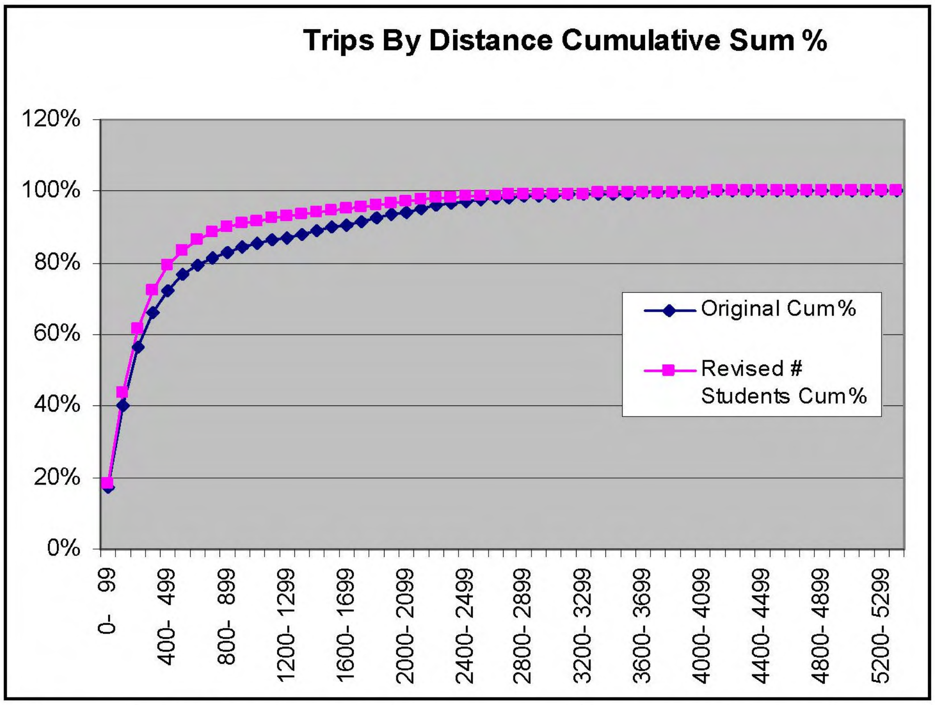


Figure 3-44: Trip Length Frequency Change of Home-based-school (K-12) Purpose

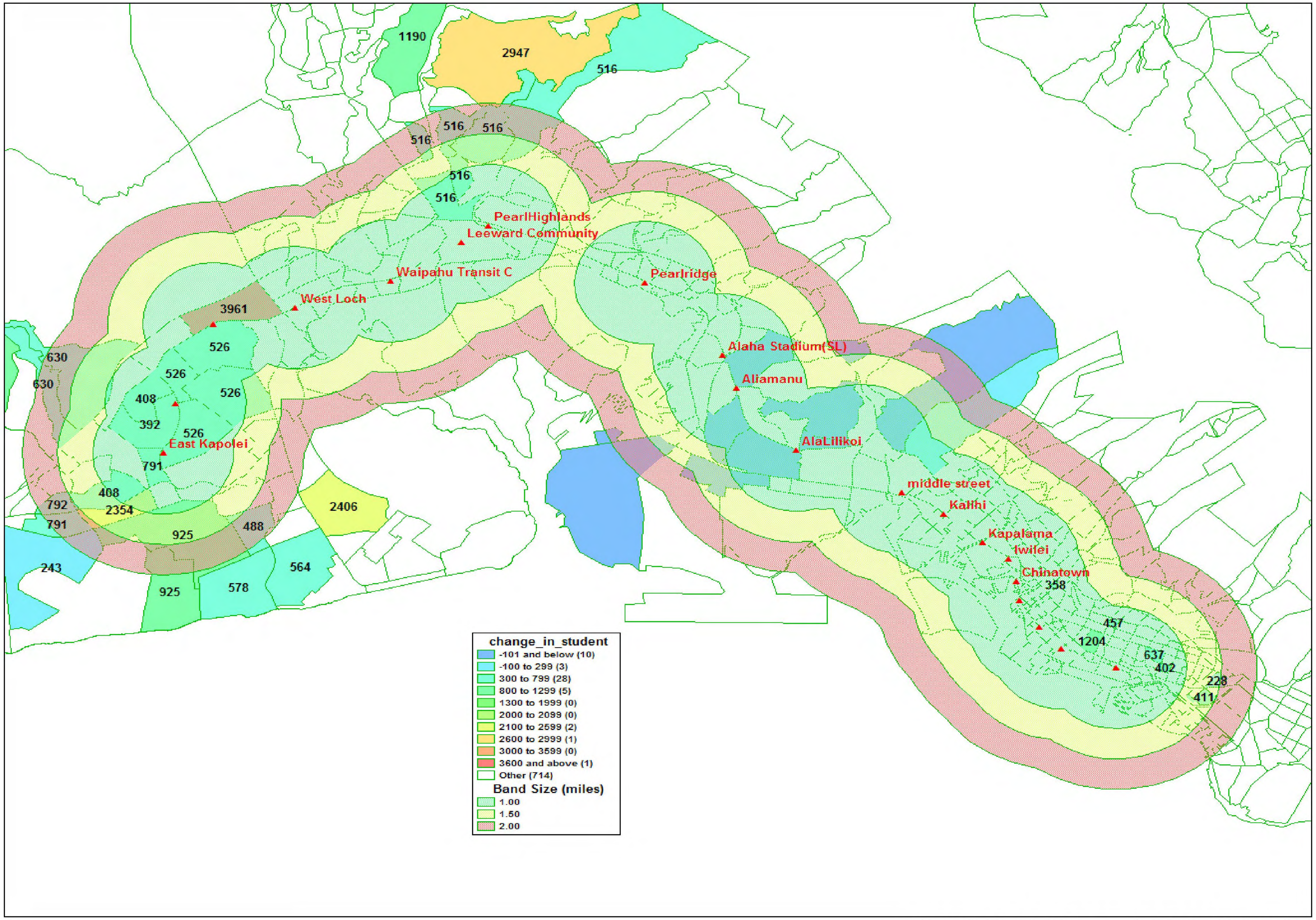


Figure 3-45: 2030 Change in Student Allocation

Table 3-44: Original 2030 Home-based-school (K-12) First Project Salt Lake Alternative Transit Person Trips

		Downtown	Kaka'ako	Mō'ili'ili–Ala Moana	Waikīkī	Kaimukī–Wai'alae	Palama–Liliha	Kalihi–Iwilei	Airport–Pearl Harbor	Salt Lake–Āliamanu	Pearl City–'Aiea	'Ewa	Kapolei	Makakilo	Waipahu–Waikele	Waiawa	Mililani	Wahiawa	East Honolulu	Kaneohe	Kailua	Ko'olau Loa	North Shore	Wai'anae	Makiki–Mānoa	UH Mānoa	Ala Moana Center	*Total*
1	Downtown	3	32	31	1	18	168	60	9	25	1	0	0	0	0	0	0	0	11	2	3	0	0	0	53	1	0	***418***
2	Kaka'ako	22	12	64	2	44	147	43	2	12	2	0	0	0	0	0	0	0	11	1	3	0	0	0	117	9	0	***491***
3	Mō'ili'ili–Ala Moana	23	40	71	11	117	91	27	1	7	0	0	0	0	0	0	1	0	43	0	4	0	0	0	156	10	0	***602***
4	Waikīkī	6	22	58	10	81	26	7	0	1	1	0	0	0	0	0	0	0	18	0	1	0	0	0	66	6	0	***303***
5	Kaimukī–Wai'alae	6	20	186	28	409	53	13	1	9	0	0	0	0	0	0	1	0	137	2	2	0	0	0	170	33	0	***1070***
6	Palama–Liliha	31	14	17	0	13	663	281	34	103	23	0	0	0	1	0	0	0	3	20	8	1	0	0	41	0	0	***1253***
7	Kalihi–Iwilei	16	28	12	0	12	260	61	32	100	15	0	0	0	0	0	0	0	4	9	3	0	0	0	40	1	0	***593***
8	Airport–Pearl Harbor	1	2	0	1	0	9	4	46	90	26	0	0	0	1	0	1	0	0	1	1	0	0	0	0	0	0	***183***
9	Salt Lake–Āliamanu	7	2	6	0	2	88	44	138	467	109	0	0	0	8	0	2	1	0	9	3	3	0	0	5	2	0	***896***
10	Pearl City–'Aiea	5	4	11	2	14	47	45	105	246	722	2	0	1	141	9	18	10	3	14	16	12	0	6	20	18	0	***1471***
11	'Ewa	32	60	114	21	138	282	76	95	152	315	806	74	21	131	4	17	22	54	35	70	95	8	85	189	162	0	***3058***
12	Kapolei	24	39	67	7	98	175	44	62	97	214	180	89	67	67	1	8	12	38	19	44	70	2	313	121	99	0	***1957***
13	Makakilo	13	21	51	7	63	122	32	41	62	127	24	24	40	28	0	4	6	25	12	27	44	1	120	82	72	0	***1048***
14	Waipahu–Waikele	21	35	57	14	68	154	39	55	88	162	103	16	14	429	60	165	67	31	17	34	50	12	51	108	87	0	***1937***
15	Waiawa	12	17	31	5	46	84	27	28	50	169	21	7	3	199	46	325	168	21	12	18	29	16	26	59	49	0	***1468***
16	Mililani	4	15	24	4	38	63	17	22	29	26	3	0	0	53	25	550	323	13	8	7	19	17	16	37	38	0	***1351***
17	Wahiawa	2	4	10	3	14	32	8	7	12	11	0	0	1	13	2	170	281	7	5	9	8	32	8	22	14	0	***675***
18	East Honolulu	7	12	72	10	245	37	5	7	8	3	0	0	0	0	0	1	1	599	2	49	5	1	1	77	22	0	***1164***
19	Kaneohe	2	1	5	3	8	74	14	16	18	7	0	0	0	3	0	0	0	3	667	201	23	1	0	9	2	0	***1057***
20	Kailua	3	4	3	0	6	78	7	5	6	3	0	0	0	2	0	1	0	7	118	857	3	0	3	11	5	0	***1122***
21	Ko'olau Loa	0	0	1	0	2	5	1	4	5	0	0	0	0	1	0	0	0	1	3	2	282	2	0	4	2	0	***315***
22	North Shore	2	7	15	5	12	33	10	9	13	7	0	0	0	2	0	15	29	6	3	4	78	268	2	19	16	0	***555***
23	Wai'anae	5	11	17	2	21	50	9	12	29	8	2	1	3	6	0	2	4	8	6	9	12	0	1196	33	28	0	***1474***
24	Makiki–Mānoa	23	25	97	5	71	114	36	1	12	0	0	0	0	1	0	0	0	21	3	2	1	0	0	189	17	0	***618***
25	UH Mānoa	1	2	5	2	10	3	1	0	1	0	0	0	0	0	0	0	0	3	0	0	0	0	0	16	1	0	***45***
26	Ala Moana Center	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	***0***
	Total	***271***	***429***	***1025***	***143***	***1550***	***2858***	***911***	***732***	***1642***	***1951***	***1141***	***211***	***150***	***1086***	***147***	***1281***	***924***	***1067***	***968***	***1377***	***735***	***360***	***1827***	***1644***	***694***	***0***	**25124**

Table 3-45: 2030 Home-based-school (K-12) First Project Salt Lake Alternative Transit Person Trips with Revised Number of Students Per Zone

		Downtown	Kakaʻako	Mōʻiliʻili–Ala Moana	Waikīkī	Kaimukī–Waiʻalae	Palama–Liliha	Kalihi–Iwilei	Airport–Pearl Harbor	Salt Lake–Āliamanu	Pearl City–ʻAiea	ʻEwa	Kapolei	Makakilo	Waipahu–Waikele	Waiawa	Mililani	Wahiawa	East Honolulu	Kaneohe	Kailua	Koʻolau Loa	North Shore	Waiʻanae	Makiki–Mānoa	UH Mānoa	Ala Moana Center	*Total*
1	Downtown	5	42	37	3	23	155	46	3	14	10	2	0	0	0	0	0	0	7	2	1	1	0	0	49	3	0	***403***
2	Kakaʻako	21	18	70	2	40	119	32	1	6	3	0	0	0	0	0	0	0	11	1	1	1	0	0	105	5	0	***436***
3	Mōʻiliʻili–Ala Moana	19	58	70	8	109	71	20	2	1	1	0	0	0	0	0	0	0	39	0	0	0	0	0	152	11	0	***561***
4	Waikīkī	5	26	67	9	73	22	5	0	0	0	0	0	0	1	0	0	0	14	1	0	0	0	0	71	5	0	***299***
5	Kaimukī–Waiʻalae	16	27	230	29	385	38	14	3	5	2	0	0	0	0	0	0	0	122	0	1	1	0	0	171	40	0	***1084***
6	Palama–Liliha	46	29	25	1	6	655	274	24	70	28	0	0	0	3	0	1	0	5	10	5	1	0	0	51	2	0	***1236***
7	Kalihi–Iwilei	24	62	19	0	6	256	56	22	63	27	0	0	0	4	1	0	0	5	3	2	0	0	0	33	5	0	***588***
8	Airport–Pearl Harbor	1	1	1	0	0	12	8	44	69	41	0	0	0	3	1	0	0	0	1	0	0	0	0	3	0	0	***185***
9	Salt Lake–Āliamanu	12	9	6	1	4	101	57	129	466	176	1	0	0	12	7	3	0	1	6	6	2	0	1	10	4	0	***1014***
10	Pearl City–ʻAiea	5	4	12	0	16	39	29	70	151	732	13	5	5	165	85	22	9	4	6	5	10	2	6	12	16	0	***1423***
11	ʻEwa	15	32	42	3	60	89	21	18	26	143	1057	357	63	88	7	10	7	16	6	10	26	1	41	60	92	0	***2290***
12	Kapolei	4	16	28	1	26	43	13	17	11	80	269	326	149	37	10	4	6	12	2	7	15	0	170	34	55	0	***1335***
13	Makakilo	5	12	21	2	18	34	7	8	14	54	61	90	113	16	7	1	2	9	3	3	13	1	67	30	36	0	***627***
14	Waipahu–Waikele	10	34	46	5	45	71	26	24	28	94	429	62	41	371	135	112	41	17	3	10	17	2	27	72	91	0	***1813***
15	Waiawa	3	12	14	2	17	20	7	5	9	79	57	21	11	141	195	205	86	4	1	5	8	7	13	22	24	0	***968***
16	Mililani	5	12	19	1	21	32	8	8	11	20	7	3	3	57	158	534	287	7	1	4	11	11	12	26	38	0	***1296***
17	Wahiawa	1	2	13	0	8	13	5	5	9	6	2	2	0	13	26	188	281	5	0	1	5	21	13	12	23	0	***654***
18	East Honolulu	14	16	96	10	250	37	10	2	4	6	0	0	1	4	2	0	0	569	1	31	8	0	1	86	31	0	***1179***
19	Kaneohe	8	8	17	5	15	110	23	10	18	11	0	1	1	2	1	0	1	5	600	175	36	2	6	20	9	0	***1084***
20	Kailua	9	7	10	1	13	100	13	4	8	12	1	0	0	1	0	0	1	9	91	634	7	0	1	19	9	0	***950***
21	Koʻolau Loa	1	2	2	0	2	3	0	0	1	1	0	0	0	0	0	1	0	1	1	1	282	2	0	4	2	0	***306***
22	North Shore	6	6	13	1	12	27	4	4	6	4	1	1	0	5	2	19	39	3	1	1	76	249	5	16	26	0	***527***
23	Waiʻanae	3	10	16	1	16	27	8	8	15	7	7	16	13	8	0	1	4	6	1	2	4	0	1190	24	34	0	***1421***
24	Makiki–Mānoa	27	32	108	4	69	98	36	1	3	1	0	0	0	0	0	0	0	17	0	3	1	0	0	201	14	0	***615***
25	UH Mānoa	0	3	6	2	6	2	1	0	0	1	0	0	0	0	0	0	0	2	1	0	0	0	0	17	2	0	***43***
26	Ala Moana Center	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	***0***
	Total	***265***	***480***	***988***	***91***	***1240***	***2174***	***723***	***412***	***1008***	***1539***	***1907***	***884***	***400***	***931***	***637***	***1101***	***764***	***890***	***742***	***908***	***525***	***298***	***1553***	***1300***	***577***	***0***	***22337***

Table 3-46: 2030 First Project Salt Lake Alternative Change in Home-based-school (K-12) Transit Person Trips (Revised-Original)

		Downtown	Kaka'ako	Mō'ili'ili–Ala Moana	Waikīkī	Kaimukī–Wai'alae	Palama–Liliha	Kalihi–Iwilei	Airport–Pearl Harbor	Salt Lake–Āliamanu	Pearl City–'Aiea	'Ewa	Kapolei	Makakilo	Waipahu–Waikele	Waiawa	Mililani	Wahiawa	East Honolulu	Kaneohe	Kailua	Ko'olau Loa	North Shore	Wai'anae	Makiki–Mānoa	UH Mānoa	Ala Moana Center	*Total*
1	Downtown	2	10	6	2	5	(13)	(14)	(6)	(11)	9	2	0	0	0	0	0	0	(4)	0	(2)	1	0	0	(4)	2	0	***(15)***
2	Kaka'ako	(1)	6	6	0	(4)	(28)	(11)	(1)	(6)	1	0	0	0	0	0	0	0	0	0	(2)	1	0	0	(12)	(4)	0	***(55)***
3	Mō'ili'ili–Ala Moana	(4)	18	(1)	(3)	(8)	(20)	(7)	1	(6)	1	0	0	0	0	0	(1)	0	(4)	0	(4)	0	0	0	(4)	1	0	***(41)***
4	Waikīkī	(1)	4	9	(1)	(8)	(4)	(2)	0	(1)	(1)	0	0	0	1	0	0	0	(4)	1	(1)	0	0	0	5	(1)	0	***(4)***
5	Kaimukī–Wai'alae	10	7	44	1	(24)	(15)	1	2	(4)	2	0	0	0	0	0	(1)	0	(15)	(2)	(1)	1	0	0	1	7	0	***14***
6	Palama–Liliha	15	15	8	1	(7)	(8)	(7)	(10)	(33)	5	0	0	0	2	0	1	0	2	(10)	(3)	0	0	0	10	2	0	***(17)***
7	Kalihi–Iwilei	8	34	7	0	(6)	(4)	(5)	(10)	(37)	12	0	0	0	4	1	0	0	1	(6)	(1)	0	0	0	(7)	4	0	***(5)***
8	Airport–Pearl Harbor	0	(1)	1	(1)	0	3	4	(2)	(21)	15	0	0	0	2	1	(1)	0	0	0	(1)	0	0	0	3	0	0	***2***
9	Salt Lake–Āliamanu	5	7	0	1	2	13	13	(9)	(1)	67	1	0	0	4	7	1	(1)	1	(3)	3	(1)	0	1	5	2	0	***118***
10	Pearl City–'Aiea	0	0	1	(2)	2	(8)	(16)	(35)	(95)	10	11	5	4	24	76	4	(1)	1	(8)	(11)	(2)	2	0	(8)	(2)	0	***(48)***
11	'Ewa	(17)	(28)	(72)	(18)	(78)	(193)	(55)	(77)	(126)	(172)	251	283	42	(43)	3	(7)	(15)	(38)	(29)	(60)	(69)	(7)	(44)	(129)	(70)	0	***(768)***
12	Kapolei	(20)	(23)	(39)	(6)	(72)	(132)	(31)	(45)	(86)	(134)	89	237	82	(30)	9	(4)	(6)	(26)	(17)	(37)	(55)	(2)	(143)	(87)	(44)	0	***(622)***
13	Makakilo	(8)	(9)	(30)	(5)	(45)	(88)	(25)	(33)	(48)	(73)	37	66	73	(12)	7	(3)	(4)	(16)	(9)	(24)	(31)	0	(53)	(52)	(36)	0	***(421)***
14	Waipahu–Waikele	(11)	(1)	(11)	(9)	(23)	(83)	(13)	(31)	(60)	(68)	326	46	27	(58)	75	(53)	(26)	(14)	(14)	(24)	(33)	(10)	(24)	(36)	4	0	***(124)***
15	Waiawa	(9)	(5)	(17)	(3)	(29)	(64)	(20)	(23)	(41)	(90)	36	14	8	(58)	149	(120)	(82)	(17)	(11)	(13)	(21)	(9)	(13)	(37)	(25)	0	***(500)***
16	Mililani	1	(3)	(5)	(3)	(17)	(31)	(9)	(14)	(18)	(6)	4	3	3	4	133	(16)	(36)	(6)	(7)	(3)	(8)	(6)	(4)	(11)	0	0	***(55)***
17	Wahiawa	(1)	(2)	3	(3)	(6)	(19)	(3)	(2)	(3)	(5)	2	2	(1)	0	24	18	0	(2)	(5)	(8)	(3)	(11)	5	(10)	9	0	***(21)***
18	East Honolulu	7	4	24	0	5	0	5	(5)	(4)	3	0	0	1	4	2	(1)	(1)	(30)	(1)	(18)	3	(1)	0	9	9	0	***15***
19	Kaneohe	6	7	12	2	7	36	9	(6)	0	4	0	1	1	(1)	1	0	1	2	(67)	(26)	13	1	6	11	7	0	***27***
20	Kailua	6	3	7	1	7	22	6	(1)	2	9	1	0	0	(1)	0	(1)	1	2	(27)	(223)	4	0	(2)	8	4	0	***(172)***
21	Ko'olau Loa	1	2	1	0	0	(2)	(1)	(4)	(4)	1	0	0	0	(1)	0	1	0	0	(2)	(1)	0	0	0	0	0	0	***(9)***
22	North Shore	4	(1)	(2)	(4)	0	(6)	(6)	(5)	(7)	(3)	1	1	0	3	2	4	10	(3)	(2)	(3)	(2)	(19)	3	(3)	10	0	***(28)***
23	Wai'anae	(2)	(1)	(1)	(1)	(5)	(23)	(1)	(4)	(14)	(1)	5	15	10	2	0	(1)	0	(2)	(5)	(7)	(8)	0	(6)	(9)	6	0	***(53)***
24	Makiki–Mānoa	4	7	11	(1)	(2)	(16)	0	0	(9)	1	0	0	0	(1)	0	0	0	(4)	(3)	1	0	0	0	12	(3)	0	***(3)***
25	UH Mānoa	(1)	1	1	0	(4)	(1)	0	0	(1)	1	0	0	0	0	0	0	0	(1)	1	0	0	0	0	1	1	0	***(2)***
26	Ala Moana Center	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	***0***
	Total	***(6)***	***51***	***(37)***	***(52)***	***(310)***	***(684)***	***(188)***	***(320)***	***(634)***	***(412)***	***766***	***673***	***250***	***(155)***	***490***	***(180)***	***(160)***	***(177)***	***(226)***	***(469)***	***(210)***	***(62)***	***(274)***	***(344)***	***(117)***	***0***	***(2,787)***

Table 3-47: Home-based-school (K-12) User Benefit Hours (Original Run)

		Downtown	Kaka'ako	Mō'ili'ili–Ala Moana	Waikīkī	Kaimukī–Wai'alae	Palama–Liliha	Kalihi–Iwilei	Airport–Pearl Harbor	Salt Lake–Āliamanu	Pearl City–'Aiea	'Ewa	Kapolei	Makakilo	Waipahu–Waikele	Waiawa	Mililani	Wahiawa	East Honolulu	Kaneohe	Kailua	Ko'olau Loa	North Shore	Wai'anae	Makiki–Mānoa	UH Mānoa	Ala Moana Center	*Total*
1	Downtown	(1)	(2)	0	0	0	(4)	5	0	8	0	0	0	0	0	0	0	0	0	(1)	0	0	0	0	2	0	0	***(1)***
2	Kaka'ako	(2)	(5)	2	0	0	5	7	0	4	1	0	0	0	0	0	0	0	0	0	(1)	0	0	0	7	1	0	***(2)***
3	Mō'ili'ili–Ala Moana	0	(2)	(1)	0	(2)	(7)	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	2	0	***0***
4	Waikīkī	(1)	(2)	(2)	0	(1)	(4)	1	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	(8)	0	0	***(1)***
5	Kaimukī–Wai'alae	0	(1)	6	1	12	(3)	1	0	1	0	0	0	0	0	0	0	0	4	0	0	0	0	0	1	2	0	***0***
6	Palama–Liliha	(2)	(2)	1	0	0	20	11	2	25	3	0	0	0	1	0	0	0	0	8	0	0	0	0	1	1	0	***(2)***
7	Kalihi–Iwilei	0	0	2	0	1	9	(13)	(1)	27	3	0	0	0	1	0	0	0	0	3	0	0	0	0	5	1	0	***0***
8	Airport–Pearl Harbor	0	0	0	0	0	2	0	25	23	(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	***0***
9	Salt Lake–Āliamanu	1	1	1	0	1	24	15	34	(67)	45	0	0	0	3	0	0	0	0	4	1	1	0	0	3	1	0	***1***
10	Pearl City–'Aiea	2	3	5	1	6	19	16	5	83	(1)	0	0	0	53	0	1	0	2	1	3	6	1	0	10	7	0	***2***
11	'Ewa	12	30	62	8	70	141	43	49	82	159	75	4	0	29	1	5	6	23	19	15	54	5	(6)	96	93	0	***12***
12	Kapolei	10	22	42	6	50	100	26	32	54	103	10	21	2	23	0	3	4	16	13	15	37	3	11	66	58	0	***10***
13	Makakilo	7	15	29	4	33	69	18	22	35	71	5	1	(3)	11	0	2	3	12	9	11	24	2	16	45	40	0	***7***
14	Waipahu–Waikele	7	18	33	4	40	75	23	27	46	63	(7)	3	0	62	8	24	15	14	11	10	44	6	(3)	52	48	0	***7***
15	Waiawa	5	8	17	3	22	44	13	15	29	37	3	2	1	56	2	11	6	8	6	8	11	7	4	26	28	0	***5***
16	Mililani	3	5	11	2	14	28	8	9	16	13	1	0	0	18	1	34	32	5	4	4	1	9	4	17	19	0	***3***
17	Wahiawa	2	2	5	1	7	13	4	5	9	4	0	0	0	5	0	105	94	2	2	2	1	18	3	7	9	0	***2***
18	East Honolulu	1	1	3	0	5	(1)	0	0	2	0	0	0	0	1	0	0	0	24	0	1	(1)	0	(1)	3	2	0	***1***
19	Kaneohe	(2)	(1)	0	0	1	(10)	6	2	8	1	0	0	0	1	0	0	0	(1)	0	(1)	0	1	0	(1)	2	0	***(2)***
20	Kailua	0	0	(1)	0	(1)	2	0	0	2	0	0	0	0	0	0	0	0	0	0	41	(1)	0	(1)	0	0	0	***0***
21	Ko'olau Loa	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	***0***
22	North Shore	2	2	6	1	8	16	4	4	8	3	0	0	0	2	0	2	5	3	2	2	5	88	1	10	10	0	***2***
23	Wai'anae	2	5	10	1	13	25	6	9	14	5	1	0	0	2	0	1	1	4	4	3	7	1	44	15	16	0	***2***
24	Makiki–Mānoa	0	2	1	0	0	(10)	(1)	0	2	0	0	0	0	0	0	0	0	(1)	0	0	0	0	0	(2)	0	0	***0***
25	UH Mānoa	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	***0***
26	Ala Moana Center	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	***0***
	Total	***46***	***99***	***235***	***32***	***279***	***553***	***196***	***240***	***415***	***509***	***88***	***31***	***0***	***268***	***12***	***188***	***166***	***116***	***85***	***114***	***189***	***141***	***72***	***360***	***341***	***0***	***46***

Table 3-48: Home-based-school (K-12) User Benefit Hours (Revised Number of Students)

		Downtown	Kaka'ako	Mō'ili'ili–Ala Moana	Waikīkī	Kaimukī–Wai'alae	Palama–Liliha	Kalihi–Iwilei	Airport–Pearl Harbor	Salt Lake–Āliamanu	Pearl City–'Aiea	'Ewa	Kapolei	Makakilo	Waipahu–Waikele	Waiawa	Mililani	Wahiawa	East Honolulu	Kaneohe	Kailua	Ko'olau Loa	North Shore	Wai'anae	Makiki–Mānoa	UH Mānoa	Ala Moana Center	*Total*
1	Downtown	0	(3)	0	0	0	2	3	(1)	4	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	0	***8***
2	Kaka'ako	(1)	(7)	2	0	(1)	3	4	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	0	***6***
3	Mō'ili'ili–Ala Moana	0	(2)	2	0	(1)	(3)	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	***2***
4	Waikīkī	(1)	(1)	(1)	0	1	(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	(1)	0	0	***(5)***
5	Kaimukī–Wai'alae	(1)	(2)	6	1	12	(3)	0	0	1	0	0	0	0	0	0	0	0	4	0	0	0	0	0	4	1	0	***23***
6	Palama–Liliha	(1)	(3)	1	0	0	(3)	4	(4)	14	4	0	0	0	2	0	0	0	0	0	0	0	0	0	1	1	0	***16***
7	Kalihi–Iwilei	1	0	1	0	0	7	(14)	(6)	12	3	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	0	***7***
8	Airport–Pearl Harbor	0	0	0	0	0	1	0	25	17	(2)	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	***42***
9	Salt Lake–Āliamanu	2	2	2	0	1	22	15	29	40	37	0	0	0	6	2	1	0	0	1	1	1	0	0	4	2	0	***168***
10	Pearl City–'Aiea	2	4	5	0	5	13	10	(5)	42	(9)	(1)	1	1	55	(4)	1	1	1	1	1	1	1	0	7	9	0	***142***
11	'Ewa	5	15	26	2	23	41	11	8	16	63	120	57	12	17	3	3	3	7	2	3	9	1	2	33	51	0	***533***
12	Kapolei	4	9	15	2	14	26	6	6	8	37	18	68	18	13	2	1	2	4	1	2	7	1	11	20	29	0	***324***
13	Makakilo	3	7	12	1	11	20	5	4	7	30	9	9	21	8	1	1	1	3	1	2	8	1	13	16	21	0	***215***
14	Waipahu–Waikele	6	16	27	3	24	41	12	9	18	36	(51)	15	7	25	10	16	9	8	2	3	0	3	(3)	34	50	0	***320***
15	Waiawa	2	3	6	1	6	11	3	2	6	13	1	6	4	22	3	9	3	2	1	1	1	2	0	7	14	0	***129***
16	Mililani	2	4	8	1	8	15	4	3	5	11	3	2	1	20	14	96	27	3	1	2	1	5	3	10	20	0	***269***
17	Wahiawa	1	1	4	1	4	7	2	1	4	3	1	0	0	6	3	114	97	1	0	0	0	10	2	4	10	0	***276***
18	East Honolulu	0	0	1	0	0	0	0	(1)	1	0	0	0	0	1	0	0	0	5	0	0	0	0	(1)	10	2	0	***18***
19	Kaneohe	0	0	1	2	3	1	1	(1)	4	2	0	0	0	2	0	0	0	0	1	0	0	0	(1)	2	6	0	***23***
20	Kailua	0	0	1	0	0	1	1	(1)	3	1	0	0	0	2	0	0	0	0	0	0	0	0	(1)	2	4	0	***13***
21	Ko'olau Loa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	(1)	0	2	0	***1***
22	North Shore	2	3	6	1	7	12	3	2	4	3	0	0	0	2	1	3	9	3	0	1	0	72	1	9	14	0	***158***
23	Wai'anae	2	5	10	1	9	16	4	3	7	5	2	1	5	3	1	1	1	2	1	1	1	0	51	12	19	0	***163***
24	Makiki–Mānoa	(1)	(2)	(3)	0	(2)	(5)	2	0	1	0	0	0	0	0	0	0	0	(1)	0	0	0	0	0	15	0	0	***4***
25	UH Mānoa	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	***3***
26	Ala Moana Center	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	***0***
	Total	***27***	***49***	***135***	***16***	***124***	***223***	***77***	***73***	***217***	***237***	***102***	***159***	***69***	***187***	***36***	***246***	***153***	***42***	***12***	***17***	***29***	***96***	***76***	***198***	***258***	***0***	***2858***

AR00040891

Table 3-49: Difference Home-based-school (K-12) User Benefit Hours (Revised-Original)

		Downtown	Kaka'ako	Mō'ili'ili–Ala Moana	Waikīkī	Kaimukī–Wai'alae	Palama–Liliha	Kalihi–Iwilei	Airport–Pearl Harbor	Salt Lake–Āliamanu	Pearl City–'Aiea	'Ewa	Kapolei	Makakilo	Waipahu–Waikele	Waiawa	Mililani	Wahiawa	East Honolulu	Kaneohe	Kailua	Ko'olau Loa	North Shore	Wai'anae	Makiki–Mānoa	UH Mānoa	Ala Moana Center	*Total*
1	Downtown	1	(1)	0	0	0	6	(2)	(1)	(4)	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	***1***
2	Kaka'ako	1	(2)	0	0	(1)	(2)	(3)	0	(2)	(1)	0	0	0	0	0	0	0	0	0	1	0	0	0	(4)	0	0	***(13)***
3	Mō'ili'ili–Ala Moana	0	0	3	0	1	4	(1)	0	(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	(3)	0	0	***3***
4	Waikīkī	0	1	1	0	2	2	(1)	0	(1)	0	0	0	0	0	0	0	0	(1)	0	0	0	0	0	7	0	0	***10***
5	Kaimukī–Wai'alae	(1)	(1)	0	0	0	0	(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	(1)	0	***(1)***
6	Palama–Liliha	1	(1)	0	0	0	(23)	(7)	(6)	(11)	1	0	0	0	1	0	0	0	0	(8)	0	0	0	0	0	0	0	***(53)***
7	Kalihi–Iwilei	1	0	(1)	0	(1)	(2)	(1)	(5)	(15)	0	0	0	0	0	0	0	0	0	(3)	0	0	0	0	(3)	(1)	0	***(31)***
8	Airport–Pearl Harbor	0	0	0	0	0	(1)	0	0	(6)	(1)	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	***(7)***
9	Salt Lake–Āliamanu	1	1	1	0	0	(2)	0	(5)	107	(8)	0	0	0	3	2	1	0	0	(3)	0	0	0	0	1	1	0	***100***
10	Pearl City–'Aiea	0	1	0	(1)	(1)	(6)	(6)	(10)	(41)	(8)	(1)	1	1	2	(4)	0	1	(1)	0	(2)	(5)	0	0	(3)	2	0	***(81)***
11	'Ewa	(7)	(15)	(36)	(6)	(47)	(100)	(32)	(41)	(66)	(96)	45	53	12	(12)	2	(2)	(3)	(16)	(17)	(12)	(45)	(4)	8	(63)	(42)	0	***(542)***
12	Kapolei	(6)	(13)	(27)	(4)	(36)	(74)	(20)	(26)	(46)	(66)	8	47	16	(10)	2	(2)	(2)	(12)	(12)	(13)	(30)	(2)	0	(46)	(29)	0	***(403)***
13	Makakilo	(4)	(8)	(17)	(3)	(22)	(49)	(13)	(18)	(28)	(41)	4	8	24	(3)	1	(1)	(2)	(9)	(8)	(9)	(16)	(1)	(3)	(29)	(19)	0	***(266)***
14	Waipahu–Waikele	(1)	(2)	(6)	(1)	(16)	(34)	(11)	(18)	(28)	(27)	(44)	12	7	(37)	2	(8)	(6)	(6)	(9)	(7)	(44)	(3)	0	(18)	2	0	***(303)***
15	Waiawa	(3)	(5)	(11)	(2)	(16)	(33)	(10)	(13)	(23)	(24)	(2)	4	3	(34)	1	(2)	(3)	(6)	(5)	(7)	(10)	(5)	(4)	(19)	(14)	0	***(243)***
16	Mililani	(1)	(1)	(3)	(1)	(6)	(13)	(4)	(6)	(11)	(2)	2	2	1	2	13	62	(5)	(2)	(3)	(2)	0	(4)	(1)	(7)	1	0	***11***
17	Wahiawa	(1)	(1)	(1)	0	(3)	(6)	(2)	(4)	(5)	(1)	1	0	0	1	3	9	3	(1)	(2)	(2)	(1)	(8)	(1)	(3)	1	0	***(24)***
18	East Honolulu	(1)	(1)	(2)	0	(5)	1	0	(1)	(1)	0	0	0	0	0	0	0	0	(19)	0	(1)	1	0	0	7	0	0	***(22)***
19	Kaneohe	2	1	1	2	2	11	(5)	(3)	(4)	1	0	0	0	1	0	0	0	1	1	1	0	(1)	(1)	3	4	0	***17***
20	Kailua	0	0	2	0	1	(1)	1	(1)	1	1	0	0	0	2	0	0	0	0	0	(41)	1	0	0	2	4	0	***(28)***
21	Ko'olau Loa	0	0	0	0	0	0	(1)	(1)	(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	(1)	0	1	0	***(3)***
22	North Shore	0	1	0	0	(1)	(4)	(1)	(2)	(4)	0	0	0	0	0	1	1	4	0	(2)	(1)	(5)	(16)	0	(1)	4	0	***(26)***
23	Wai'anae	0	0	0	0	(4)	(9)	(2)	(6)	(7)	0	1	1	5	1	1	0	0	(2)	(3)	(2)	(6)	(1)	7	(3)	3	0	***(26)***
24	Makiki–Mānoa	(1)	(4)	(4)	0	(2)	5	3	0	(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	***13***
25	UH Mānoa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	***0***
26	Ala Moana Center	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	***0***
	Total	***(19)***	***(50)***	***(100)***	***(16)***	***(155)***	***(330)***	***(119)***	***(167)***	***(198)***	***(272)***	***14***	***128***	***69***	***(81)***	***24***	***58***	***(13)***	***(74)***	***(73)***	***(97)***	***(160)***	***(45)***	***4***	***(162)***	***(83)***	***0***	***(1917)***

Table 3-50: Change in User Benefits after Student Redistribution

Source	Description	Non-work-related—Home-based-school (K-12) Original Student Distribution (1/24/08 run)	Non-work-related—Home-based-school (K-12) with Revised Number of Students (5/29/08 run)	Difference
SUMMIT	Total user benefits	329,958	193,529	(136,429)
	Capped user benefits	286,495	172,406	(114,089)
	Percent of total	*15.1%*	*9.1%*	
	Percent of capped	*13.2%*	*10.9%*	
	Baseline transit trips	22,677	20,918	(1,759)
	Build transit trips	25,219	22,440	(2,779)
	New riders	2,542	1,522	(1,020)
USERBENC	**Existing Rider Statistics**			
	Number	17,856	15,067	
	Benefits (minutes)	265,352	146,368	
	User benefit per existing rider	14.9	9.7	
	New Rider Statistics			
	Number	2,883	1,802	
	Benefits (minutes)	78,833	53,049	
	User benefit per new rider	27.3	29.4	
	User benefits with urban rail available	297,920	146,031	
	Percent change in user benefits	90.29%	75.46%	
	Estimated capped user benefits associated with urban rail	545,173	302,498	
	Non-included Attributed User Benefits			
	all access transit markets	286,495	172,406	(114,089)
	in-vehicle time savings walk access	22,885	10,596	(12,289)
	guideway + local inveh savings walk access	34,166	19,421	(14,745)
	guideway only inveh savings walk access	1,930	1,412	(518)
	in-vehicle time savings PNR access	424	279	(145)
	guideway + local inveh savings PNR access	737	572	(165)
	guideway only inveh savings PNR access	580	247	(333)
	in-vehicle time savings KNR access	2,383	182	(2,201)
	guideway + local inveh savings KNR access	3,163	385	(2,778)
	guideway only inveh savings KNR access	1,987	131	(1,856)
	guideway only savings all access	354,750	205,631	(149,119)
			Change In User Benefits	***-42.0%***

The magnitude of the college benefits to UH Mānoa were a concern as well because of the benefits from students on the western side of the island commuting by rail to the UH Mānoa campus. Table 3-51 shows UH Mānoa's growth is modest over the 25-year span. However, the addition of the UH West O'ahu campus in 2030 will affect the distribution of trips and the overall student commuting pattern. The change in students was not presenting the correct trip distribution in the future because the control totals were held constant on the locations and, therefore, the trip distribution remained the same.

Table 3-51: College Student Growth on O'ahu

TAZ	College Name	2005 Private Colleges	2005 Public Colleges	2030 Private Colleges	2030 Public Colleges
38		126	0	164	0
54	Chaminade	918	0	1198	0
66	UH Mānoa	0	22,732	0	26,908
103	Kapi'olani Community College	0	8,345	0	9,879
146		103	0	134	0
185		40	0	52	0
193		34	0	44	0
252	Hawai'i Pacific University	5,018	0	6549	0
255		36	0	47	0
261		344	0	449	0
334	Honolulu Community College	0	5,377	0	6,366
440	Leeward Community College	0	8,083	0	9,568
604	UH West O'ahu	0	0	0	7,600
668	Brigham Young University	2,268	0	2960	0
702	Windward Community College	0	1,855	0	2,195

Student residencies by district were obtained from UH Mānoa and grouped into district clusters to determine the college student percentage distribution on Oʻahu. Table 3-52 shows the observed distribution data by district cluster from UH Mānoa.

Table 3-52: Observed UH Mānoa Student Distribution

District Cluster	% Students
1	2.8%
2, 3, 26	9.6%
4	4.3%
5	8.0%
6, 7	5.7%
8, 9	7.6%
10	9.1%
11, 12, 13	3.3%
14	3.6%
15, 16, 17	6.4%
18	7.4%
19, 21	6.6%
20	5.6%
22	1.1%
23	1.4%
24, 25	17.5%

In order to fix the 2030 college trip distribution problem, the original trip distribution for the home-based-college (NC) purpose was re-balanced using a process similar to frataring. The control total attractions for UH Mānoa were held constant, but the district productions were changed to match the percentages in Table 3-52. As shown in Table 3-53, the mode choice effect of the distribution change was minimal but achieved a more reasonable table of district-to-district flows for the future. Table 3-54 shows the changes made to the UH Mānoa distribution in district format.

Table 3-53: Mode Choice Difference of Home-based-college Purpose

	NC–Original	NC–Revised Productions to UH Mānoa	Difference between Revised and Original	Percent Difference
Single occupant auto (1-occ)	31,253	31,480	227	0.73%
HOV 2 auto (2-occ)	6,872	6,641	(231)	-3.36%
HOV 3+ auto (3+occ)	2,059	1,882	(177)	-8.60%
Walk to express bus (wk-prem)	24	12	(12)	-50.00%
Walk to local/limited stop bus (wk-ngdw)	8,426	8,690	264	3.13%
Walk to guideway (wk-gdwy)	9,944	8,998	(946)	-9.51%
Drive access park-and-ride (drv-pnr)	702	935	233	33.19%
Drive access kiss-and-ride (drv-knr)	2,096	1,305	(791)	-37.74%
Auxiliary walk (aux-w)	3,966	4,466	500	12.61%
Auxiliary bike (aux-b)	3,261	4,153	892	27.35%
Total	***68,603***	***68,562***	***(41)***	***-0.06%***

Table 3-54: UH Mānoa Student Changes by District

District Number	District	Original Distribution	Revised Distribution	Difference
1	Downtown	385	697	312
2	Kaka‘ako	841	918	77
3	Mō‘ili‘ili-Ala Moana	1328	1447	119
4	Waikiki	635	1066	431
5	Kaimukī-Wai‘alae	1715	1980	265
6	Palama-Liliha	1370	1051	(319)
7	Kalihi-Iwilei	487	376	(111)
8	Airport-Pearl Harbor	249	321	72
9	Salt Lake-Āliamanu	1205	1560	355
10	Pearl City-‘Aiea	1705	2255	550
11	‘Ewa	1432	442	(990)
12	Kapolei	735	226	(509)
13	Makakilo	495	149	(346)
14	Waipahu-Waikele	1017	897	(120)
15	Waiawa	900	496	(404)
16	Mililani	1230	676	(554)
17	Wahiawa	776	426	(350)
18	East Honolulu	2001	1842	(159)
19	Kaneohe	1333	1443	110
20	Kailua	1684	1397	(287)
21	Ko‘olau Loa	176	191	15
22	North Shore	491	275	(216)
23	Wai‘anae	999	339	(660)
24	Makiki-Mānoa	1519	4043	2524
25	UH Mānoa	115	307	192
26	Ala Moana Center	0	0	0

The ultimate goal was to assure that the college student movement was not providing unintended benefits to rail. Table 3-55 shows that the manual adjustment to home-based-college resulted in a 13-percent reduction in benefits. Table 3-56 shows the original UH benefits. Table 3-57 shows the adjusted benefits and Table 3-58 shows the change and reduction in benefits as a result of the re-allocation.

Table 3-55: User Benefit Comparison for Home-based-college Purpose

Source	Description	Non-work-related—Home-based-college	Non-work-related—Home-based-college with Revised Productions to UH Mānoa	Difference
SUMMIT	Total user benefits	349,105	299,901	(49,204)
	Capped user benefits	291,171	261,288	(29,883)
	Percent of total	15.4%	13.8%	
	Percent of capped	16.6%	12.9%	
	Baseline transit trips	349,105	299,901	(49,204)
	Build transit trips	291,171	261,288	(29,883)
	New riders	15.4%	13.8%	
USERBENC	**Existing Rider Statistics**			
	Number	10,970	9,861	
	Benefits (minutes)	200,048	173,654	
	User benefit per existing rider	18.2	17.6	
	New Rider Statistics			
	Number	5,511	4,665	
	Benefits (minutes)	109,960	89,783	
	User benefit per new rider	20.0	19.2	
	User benefits with urban rail available	301,055	288,325	(12,730)
	Percent change in user benefits	86.24%	96.14%	
	Estimated capped user benefits associated with urban rail	542,266	512,490	(29,776)
	Non-included Attributed User Benefits			
	all access transit markets	291,171	261,288	(29,883)
	in-vehicle time savings walk access	32,839	23,034	(9,805)
	guideway + local inveh savings walk access	49,671	45,067	(4,604)
	guideway only inveh savings walk access	7,696	6,684	(1,012)
	in-vehicle time savings PNR access	1,354	1,614	260
	guideway + local inveh savings PNR access	1,375	1,903	528
	guideway only inveh savings PNR access	3,118	4,205	1,087
	in-vehicle time savings KNR access	5,699	2,552	(3,147)
	guideway + local inveh savings KNR access	6,001	3,229	(2,772)
	guideway only inveh savings KNR access	7,946	4,191	(3,755)
	guideway only savings all access	406,870	353,767	(53,103)
			Percent Difference	***-13.05%***

Table 3-56: Home-based-college District-to-district User Benefit Hours—Original Distribution

		Downtown	Kaka'ako	Mō'ili'ili–Ala Moana	Waikīkī	Kaimukī–Wai'alae	Palama–Liliha	Kalihi–Iwilei	Airport–Pearl Harbor	Salt Lake–Āliamanu	Pearl City–'Aiea	'Ewa	Kapolei	Makakilo	Waipahu–Waikele	Waiawa	Mililani	Wahiawa	East Honolulu	Kaneohe	Kailua	Ko'olau Loa	North Shore	Wai'anae	Makiki–Mānoa	UH Mānoa	Ala Moana Center	*Total*
1	Downtown	(2)	0	0	0	(12)	0	(2)	0	0	0	0	1	0	11	0	0	0	0	(2)	0	(2)	0	0	0	16	0	***8***
2	Kaka'ako	(6)	0	0	0	(10)	0	0	0	0	0	0	2	0	15	0	0	0	0	1	0	(1)	0	0	0	34	0	***35***
3	Mō'ili'ili–Ala Moana	(13)	0	0	0	(25)	0	2	0	0	0	0	1	0	19	0	0	0	0	0	0	(1)	0	0	0	45	0	***28***
4	Waikīkī	(15)	0	0	0	21	0	(1)	0	0	0	0	1	0	7	0	0	0	0	0	0	(1)	0	0	0	(3)	0	***9***
5	Kaimukī–Wai'alae	(1)	0	0	0	3	0	0	0	0	0	0	1	0	12	0	0	0	0	0	0	0	0	0	0	21	0	***36***
6	Palama–Liliha	(4)	0	0	0	(8)	0	(3)	0	0	0	0	5	0	36	0	0	0	0	0	0	2	0	0	0	72	0	***100***
7	Kalihi–Iwilei	5	0	0	0	0	0	0	0	0	0	0	1	0	16	0	0	0	0	2	0	2	0	0	0	34	0	***60***
8	Airport–Pearl Harbor	3	0	0	0	1	0	0	0	0	0	0	1	0	10	0	0	0	0	1	0	1	0	0	0	18	0	***35***
9	Salt Lake–Āliamanu	27	0	1	0	8	0	23	0	0	0	0	17	0	61	0	0	0	0	3	0	6	0	0	0	146	0	***292***
10	Pearl City–'Aiea	45	0	1	0	26	0	29	0	0	0	0	14	0	121	0	0	0	0	6	0	6	0	0	0	231	0	***479***
11	'Ewa	55	0	1	0	45	0	38	0	0	0	0	(72)	0	137	0	0	0	1	8	0	13	0	0	0	354	0	***580***
12	Kapolei	35	0	2	0	27	0	17	0	0	0	0	5	0	79	0	0	0	1	4	0	7	0	0	0	185	0	***362***
13	Makakilo	23	0	1	0	20	0	12	0	0	0	0	14	0	40	0	0	0	0	3	0	3	0	0	0	132	0	***248***
14	Waipahu–Waikele	39	0	0	0	31	0	29	0	0	0	0	15	0	124	0	0	0	0	6	0	9	0	0	0	222	0	***475***
15	Waiawa	32	0	0	0	23	0	25	0	0	0	0	29	0	85	0	0	0	0	5	0	5	0	0	0	209	0	***413***
16	Mililani	48	0	0	0	29	0	27	0	0	0	0	43	0	128	0	0	0	0	7	0	1	0	0	0	268	0	***551***
17	Wahiawa	24	0	1	0	17	0	16	0	0	0	0	22	0	64	0	0	0	0	3	0	1	0	0	0	194	0	***342***
18	East Honolulu	8	0	0	0	5	0	(2)	0	0	0	0	1	0	9	0	0	0	0	0	0	(1)	0	0	0	82	0	***102***
19	Kaneohe	(32)	0	0	0	(9)	0	(1)	0	0	0	0	3	0	19	0	0	0	0	(1)	0	(1)	0	0	0	57	0	***35***
20	Kailua	5	0	0	0	(14)	0	(7)	0	0	0	0	(1)	0	20	0	0	0	0	(1)	0	(4)	0	0	0	27	0	***25***
21	Ko'olau Loa	(3)	0	0	0	(1)	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	13	0	***11***
22	North Shore	12	0	0	0	10	0	7	0	0	0	0	6	0	18	0	0	0	0	1	0	5	0	0	0	113	0	***172***
23	Wai'anae	37	0	1	0	29	0	20	0	0	0	0	31	0	60	0	0	0	1	4	0	5	0	0	0	246	0	***434***
24	Makiki–Mānoa	(3)	0	0	0	(5)	0	1	0	0	0	0	1	0	11	0	0	0	0	0	0	(1)	0	0	0	13	0	***17***
25	UH Mānoa	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	***1***
26	Ala Moana Center	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	***0***
	Total	***319***	***0***	***8***	***0***	***211***	***0***	***230***	***0***	***0***	***0***	***0***	***141***	***0***	***1105***	***0***	***0***	***0***	***3***	***50***	***0***	***54***	***0***	***0***	***0***	***2729***	***0***	***4850***

Table 3-57: Home-based-college District-to-district User Benefit Hours-Revised Student Distribution

		Downtown	Kaka'ako	Mō'ili'ili–Ala Moana	Waikīkī	Kaimukī–Wai'alae	Palama–Liliha	Kalihi–Iwilei	Airport–Pearl Harbor	Salt Lake–Āliamanu	Pearl City–'Aiea	'Ewa	Kapolei	Makakilo	Waipahu–Waikele	Waiawa	Mililani	Wahiawa	East Honolulu	Kaneohe	Kailua	Ko'olau Loa	North Shore	Wai'anae	Makiki–Mānoa	UH Mānoa	Ala Moana Center	*Total*
1	Downtown	(1)	0	0	0	(12)	0	(2)	0	0	0	0	1	0	12	0	0	0	0	0	0	0	0	0	0	32	0	***30***
2	Kaka'ako	(3)	0	0	0	(12)	0	(2)	0	0	0	0	3	0	16	0	0	0	0	0	0	0	0	0	0	33	0	***35***
3	Mō'ili'ili–Ala Moana	(8)	0	0	0	(24)	0	6	0	0	0	0	1	0	20	0	0	0	0	0	0	0	0	0	0	48	0	***43***
4	Waikīkī	(9)	0	0	0	30	0	3	0	0	0	0	1	0	8	0	0	0	0	0	0	0	0	0	0	24	0	***57***
5	Kaimukī–Wai'alae	(2)	0	0	0	4	0	0	0	0	0	0	2	0	12	0	0	0	0	0	0	0	0	0	0	22	0	***38***
6	Palama–Liliha	8	0	1	0	(2)	0	(4)	0	0	0	0	5	0	38	0	0	0	0	0	0	0	0	0	0	63	0	***109***
7	Kalihi–Iwilei	6	0	0	0	(2)	0	0	0	0	0	0	1	0	16	0	0	0	0	0	0	0	0	0	0	18	0	***39***
8	Airport–Pearl Harbor	4	0	0	0	1	0	0	0	0	0	0	1	0	8	0	0	0	0	0	0	0	0	0	0	22	0	***36***
9	Salt Lake–Āliamanu	36	0	1	0	11	0	26	0	0	0	0	16	0	60	0	0	0	0	1	0	2	0	0	0	206	0	***359***
10	Pearl City–'Aiea	56	0	1	0	31	0	33	0	0	0	0	16	0	113	0	0	0	0	2	0	4	0	0	0	345	0	***601***
11	'Ewa	59	0	1	0	48	0	39	0	0	0	0	105	0	132	0	0	0	1	2	0	6	0	0	0	111	0	***504***
12	Kapolei	35	0	2	0	27	0	17	0	0	0	0	6	0	76	0	0	0	1	1	0	4	0	0	0	56	0	***225***
13	Makakilo	24	0	1	0	20	0	13	0	0	0	0	23	0	39	0	0	0	0	1	0	2	0	0	0	39	0	***162***
14	Waipahu–Waikele	41	0	1	0	32	0	30	0	0	0	0	21	0	117	0	0	0	0	2	0	3	0	0	0	205	0	***452***
15	Waiawa	28	0	0	0	18	0	20	0	0	0	0	21	0	58	0	0	0	0	1	0	2	0	0	0	103	0	***251***
16	Mililani	53	0	0	0	34	0	30	0	0	0	0	47	0	136	0	0	0	0	3	0	1	0	0	0	160	0	***464***
17	Wahiawa	24	0	1	0	18	0	15	0	0	0	0	21	0	60	0	0	0	0	1	0	1	0	0	0	113	0	***254***
18	East Honolulu	2	0	0	0	6	0	(4)	0	0	0	0	2	0	10	0	0	0	0	0	0	0	0	0	0	58	0	***74***
19	Kaneohe	1	0	0	0	(4)	0	(6)	0	0	0	0	3	0	22	0	0	0	0	0	0	0	0	0	0	96	0	***112***
20	Kailua	1	0	0	0	(5)	0	(8)	0	0	0	0	2	0	28	0	0	0	0	0	0	0	0	0	0	90	0	***108***
21	Ko'olau Loa	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	12	0	***14***
22	North Shore	12	0	0	0	10	0	7	0	0	0	0	5	0	16	0	0	0	0	0	0	1	0	0	0	61	0	***112***
23	Wai'anae	39	0	1	0	31	0	21	0	0	0	0	32	0	60	0	0	0	1	2	0	1	0	0	0	83	0	***271***
24	Makiki–Mānoa	1	0	0	0	(7)	0	0	0	0	0	0	2	0	13	0	0	0	0	0	0	0	0	0	0	(12)	0	***(3)***
25	UH Mānoa	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	***1***
26	Ala Moana Center	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	***0***
	Total	***408***	***0***	***10***	***0***	***253***	***0***	***234***	***0***	***0***	***0***	***0***	***337***	***0***	***1072***	***0***	***0***	***0***	***3***	***16***	***0***	***27***	***0***	***0***	***0***	***1988***	***0***	***4348***

Table 3-58: Difference in User Benefit Hours for Home-based-college Purpose

		Downtown	Kaka'ako	Mō'ili'ili–Ala Moana	Waikīkī	Kaimukī–Wai'alae	Palama–Liliha	Kalihi–Iwilei	Airport–Pearl Harbor	Salt Lake–Āliamanu	Pearl City–'Aiea	'Ewa	Kapolei	Makakilo	Waipahu–Waikele	Waiawa	Mililani	Wahiawa	East Honolulu	Kaneohe	Kailua	Ko'olau Loa	North Shore	Wai'anae	Makiki–Mānoa	UH Mānoa	Ala Moana Center	*Total*
1	Downtown	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	0	2	0	0	0	16	0	***22***
2	Kaka'ako	3	0	0	0	(2)	0	(2)	0	0	0	0	1	0	1	0	0	0	0	(1)	0	1	0	0	0	(1)	0	***0***
3	Mō'ili'ili–Ala Moana	5	0	0	0	1	0	4	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	3	0	***15***
4	Waikīkī	6	0	0	0	9	0	4	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	27	0	***48***
5	Kaimukī–Wai'alae	(1)	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	***2***
6	Palama–Liliha	12	0	1	0	6	0	(1)	0	0	0	0	0	0	2	0	0	0	0	0	0	(2)	0	0	0	(9)	0	***9***
7	Kalihi–Iwilei	1	0	0	0	(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	(2)	0	(2)	0	0	0	(16)	0	***(21)***
8	Airport–Pearl Harbor	1	0	0	0	0	0	0	0	0	0	0	0	0	(2)	0	0	0	0	(1)	0	(1)	0	0	0	4	0	***1***
9	Salt Lake–Āliamanu	9	0	0	0	3	0	3	0	0	0	0	(1)	0	(1)	0	0	0	0	(2)	0	(4)	0	0	0	60	0	***67***
10	Pearl City–'Aiea	11	0	0	0	5	0	4	0	0	0	0	2	0	(8)	0	0	0	0	(4)	0	(2)	0	0	0	114	0	***122***
11	'Ewa	4	0	0	0	3	0	1	0	0	0	0	177	0	(5)	0	0	0	0	(6)	0	(7)	0	0	0	(243)	0	***(76)***
12	Kapolei	0	0	0	0	0	0	0	0	0	0	0	1	0	(3)	0	0	0	0	(3)	0	(3)	0	0	0	(129)	0	***(137)***
13	Makakilo	1	0	0	0	0	0	1	0	0	0	0	9	0	(1)	0	0	0	0	(2)	0	(1)	0	0	0	(93)	0	***(86)***
14	Waipahu–Waikele	2	0	1	0	1	0	1	0	0	0	0	6	0	(7)	0	0	0	0	(4)	0	(6)	0	0	0	(17)	0	***(23)***
15	Waiawa	(4)	0	0	0	(5)	0	(5)	0	0	0	0	(8)	0	(27)	0	0	0	0	(4)	0	(3)	0	0	0	(106)	0	***(162)***
16	Mililani	5	0	0	0	5	0	3	0	0	0	0	4	0	8	0	0	0	0	(4)	0	0	0	0	0	(108)	0	***(87)***
17	Wahiawa	0	0	0	0	1	0	(1)	0	0	0	0	(1)	0	(4)	0	0	0	0	(2)	0	0	0	0	0	(81)	0	***(88)***
18	East Honolulu	(6)	0	0	0	1	0	(2)	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	0	0	(24)	0	***(28)***
19	Kaneohe	33	0	0	0	5	0	(5)	0	0	0	0	0	0	3	0	0	0	0	1	0	1	0	0	0	39	0	***77***
20	Kailua	(4)	0	0	0	9	0	(1)	0	0	0	0	3	0	8	0	0	0	0	1	0	4	0	0	0	63	0	***83***
21	Ko'olau Loa	4	0	0	0	1	0	0	0	0	0	0	0	0	(1)	0	0	0	0	0	0	0	0	0	0	(1)	0	***3***
22	North Shore	0	0	0	0	0	0	0	0	0	0	0	(1)	0	(2)	0	0	0	0	(1)	0	(4)	0	0	0	(52)	0	***(60)***
23	Wai'anae	2	0	0	0	2	0	1	0	0	0	0	1	0	0	0	0	0	0	(2)	0	(4)	0	0	0	(163)	0	***(163)***
24	Makiki–Mānoa	4	0	0	0	(2)	0	(1)	0	0	0	0	1	0	2	0	0	0	0	0	0	1	0	0	0	(25)	0	***(20)***
25	UH Mānoa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	***0***
26	Ala Moana Center	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	***0***
	Total	***89***	***0***	***2***	***0***	***42***	***0***	***4***	***0***	***0***	***0***	***0***	***196***	***0***	***(33)***	***0***	***0***	***0***	***0***	***(34)***	***0***	***(27)***	***0***	***0***	***0***	***(741)***	***0***	***(502)***

3.2.2 Update of Visitor Model

Land use changes on O'ahu and the update of the travel demand model to a 2005 base year made it important to accurately reflect current visitor travel characteristics.

Table 3-60 shows visitors by destination and mode as reported in the 1991 visitor survey. Note that the survey explicitly captured travel information from visitors if they were destined to one of 25 key destinations. Since a new visitor survey has not been performed recently, the 1991 trips by mode and destination were scaled up to 2005 data based on the increase in visitors as reported by the Hawaii Department of Business, Economic Development and Tourism (DBEDT) (Table 3-59). According to this data, visitors on O'ahu increased from 75,000 per day in 1991 to 89,500 per day in 2005, an increase of over 19 percent. The 1991 visitor trips by mode and destination were, therefore, scaled up by 19 percent. Finally, the scaled 2005 transit trips to each destination were replaced by the observed 2005 transit OBS visitor trips. The final 2005 observed visitor trips by mode and destination are shown in Table 3-61.

Table 3-59: Visitor Growth Statistics

	1991	2005	Percent Difference
Visitors from DBEDT statistics (per day)	75008	89588	19.44 %
Model hotel and resort units	35325	35846	1.47 %

The modal constants and destination constants were calibrated to match the scaled observed data. It was determined that the model land-use data did not show a commensurate increase in total hotel rooms from 1991 to 2005, based on the 1991 Honolulu High-Capacity Transit Preliminary Engineering Report input data. However, the visitor statistics from DBEDT indicate a 19.44 percent increase in visitors during this same time (Table 3-59). It may be that the 1991 data over-counted hotel rooms or that an increase in condo units, which may not be counted as visitor units, is partially responsible for the difference. The calibration compensates for the inconsistency by scaling destination choice constants up so that the correct number of trips to each destination is generated.

During calibration, two key changes were made to the visitor model. The original model application code allowed relatively long walk trips (3 miles maximum walk distance), despite the fact that they do not occur very frequently in the observed data. Therefore, the walk mode was capped at 1.5 miles. Second, there are four market segments in the application program—two segments of auto availability and two segments of tour participation. Unfortunately, the original code did not set the tour bus mode as unavailable if the trip was not a tour participant. This was corrected in the revised code.

The initial model calibration resulted in an under-estimate of walk trips in Waikīkī, indicating that the visitor model does not understand the agglomeration of walk-accessible attractions in Waikīkī. To compensate for this, a Waikīkī walk constant was added to the model and was calibrated to match walk shares for trips internal to Waikīkī. Its final calibrated value is worth approximately 60 minutes of in-vehicle time (IVT). The initial visitor model also resulted in an over-estimate of both walk and tour bus trips to AMC (despite the addition of the intra-Waikīkī walk constant). An Ala Moana walk constant and an Ala Moana tour bus constant were added to the model to compensate for this. Interestingly, the negative Ala Moana walk constant exactly cancels the positive global walk constant for trips to Ala Moana (approximately 100 minutes of IVT). The negative tour-bus constant is worth approximately 90 minutes of IVT.

Finally, the observed transit visitor trip table to the non-25 destinations was updated based on the 2005 OBS data. The observed 2005 visitor transit trips to 25 destinations are shown in Table 3-62, and estimated 2005 visitor transit trips to 25 destinations are given in Table 3-63; as shown, the estimated district-level trip table matches observed well.

The visitor model underestimates the district flows intentionally due to the reliability of the HIS survey data. Respondents stated AMC was their destination when in fact it was merely a transfer point as previously discussed in a previous section of the report.

The visitor model also had a few other changes that needed to be implemented in order to assure the visitor model was calibrated and distributed tours correctly.

- The out-of-pocket cost parameter had a typo. It should be -0.003816, but was set to -0.0003816 (an extra zero).
- The “No Tour Use” market segments 1 and 2 do not shut down the tour mode (mode 5). Therefore, it is always available and gets a big share of trips in these market segments.

The maximum walk time was set to 60 minutes. This was reduced to 30 minutes, which disallows walk from Waikīkī to AMC for the Hilton and points east.

Table 3-60: 1991 Visitors by Destination and Mode

	Destination	Auto	Bus	Taxi	Tour	Walk	*Total*
1	Ala Moana Park	3,877	3,694	336	1,099	3,144	***12,150***
2	Ala Moana Center	13,547	17,052	3,308	1,969	7,837	***43,713***
3	Aloha Stadium	2,550	1,293	122	367	70	***4,402***
4	Aloha Tower	950	287	111	729	88	***2,165***
5	Bishop Museum	1,036	661	36	161	0	***1,894***
6	Chinatown	2,346	1,970	111	1,726	243	***6,396***
7	Diamond Head	7,929	1,914	298	4,076	1,566	***15,783***
8	Dole Cannery Square	3,544	1,196	111	3,499	66	***8,416***
9	Downtown Honolulu	6,324	3,224	532	2,097	1,346	***13,523***
10	Hanauma Bay	7,944	2,464	461	3,247	138	***14,254***
11	Honolulu Zoo	637	531	64	106	2,589	***3,927***
12	International Marketplace	5,195	3,070	767	295	52,010	***61,337***
13	‘Iolani Palace	918	761	45	2,082	202	***4,008***
14	Kodak Hula Show	469	319	56	131	863	***1,838***
15	Arizona Memorial	6,049	2,648	234	4,569	130	***13,630***
16	Pearl Harbor	5,041	1,740	128	3,045	51	***10,005***
17	Pearlridge Center	2,014	427	81	142	41	***2,705***
18	Polynesian Cultural Center	3,026	429	61	3,741	41	***7,298***
19	Punchbowl National Cemetery	3,021	629	76	6,671	201	***10,598***
20	Royal Hawaiian Center	1,471	883	294	147	20,230	***23,025***
21	U.S. Army Museum	305	98	0	54	980	***1,437***
22	University of Hawaii	1,162	570	132	614	373	***2,851***
23	Waikīkī Aquarium	756	336	42	63	1,659	***2,856***
24	Waikīkī Beaches	5,158	1,719	377	252	53,756	***61,262***
25	Waimea Falls Park	4,348	576	0	1,628	40	***6,592***
	Totals	***89,617***	***48,491***	***7,783***	***42,510***	***147,664***	***336,065***

Table 3-61: 2005 Observed Visitor Trips

		Observed from Survey			Estimated Trips with Waikiki Constant Only			Final Calibration with Waikiki and Ala Moana Center Constants			Percent Difference (Final-Observed)
		Tour	Walk	Total	Tour	Walk	Total	Tour	Walk	Total	
1	Ala Moana Park	1313	3755	10459	2137	3875	10373	2303	4373	10441	-0.17%
2	Ala Moana Center	2352	9360	36955	7511	14032	36618	2415	9659	36528	-1.16%
3	Aloha Stadium	438	84	3719	1184	0	3657	1358	0	3715	-0.12%
4	Aloha Tower	871	105	2546	760	17	2504	890	20	2543	-0.11%
5	Bishop Museum	192	0	1508	370	1	1483	438	2	1507	-0.03%
6	Chinatown	2061	290	5517	1584	53	5426	1856	62	5506	-0.19%
7	Diamond Head	4868	1870	17193	3032	0	16901	3704	0	17102	-0.53%
8	Dole Cannery Square	4179	79	8806	3046	13	8659	3456	15	8780	-0.30%
9	Downtown Honolulu	2505	1608	12777	3939	116	12565	4590	132	12720	-0.45%
10	Hanauma Bay	3878	165	14773	3389	0	14521	3953	0	14707	-0.44%
11	Honolulu Zoo	127	3092	4244	327	3585	4766	256	3496	4284	0.94%
12	International Marketplace	352	62119	70373	1593	66522	74936	1195	64172	69553	-1.16%
13	ʻIolani Palace	2487	241	4638	1312	51	4561	1542	61	4630	-0.16%
14	Kodak Hula Show	156	1031	1814	254	942	3124	279	1163	3040	67.56%
15	Arizona Memorial	5457	155	13597	3847	0	13365	4404	0	13537	-0.44%
16	Pearl Harbor	3637	61	10045	2662	0	9876	3088	0	10013	-0.32%
17	Pearlridge Center	170	49	3262	966	19	3208	1110	22	3260	-0.09%
18	Polynesian Cultural Center	4468	49	8281	2805	0	8141	3141	0	8260	-0.26%
19	Punchbowl National Cemetery	7968	240	11907	3218	0	11705	3738	0	11863	-0.37%
20	Royal Hawaiian Center	176	24162	26770	328	28714	30368	201	26025	26899	0.48%
21	U.S. Army Museum	64	1170	2023	71	2084	2331	48	1906	2047	1.17%
22	University of Hawaii	733	446	3101	761	8	3050	912	9	3098	-0.11%
23	Waikiki Aquarium	75	1981	3027	254	942	3124	279	1163	3040	0.42%
24	Waikiki Beaches	301	64205	71152	5426	56144	74209	4808	56418	70011	-1.60%
25	Waimea Falls Park	1944	48	7390	2713	0	7266	3031	0	7371	-0.25%
	Totals	***50773***	***176366***	***355878***	***53489***	***177119***	***366737***	***52993***	***168699***	***354455***	***-0.40%***

Table 3-62: Observed Visitor Daily Transit Trips (P to A format)

		Downtown	Kaka'ako	Mō'ili'ili–Ala Moana	Waikīkī	Kaimukī–Wai'alae	Palama–Liliha	Kalihi–Iwilei	Airport–Pearl Harbor	Salt Lake–Āliamanu	Pearl City–'Aiea	'Ewa	Kapolei	Makakilo	Waipahu–Waikele	Waiawa	Mililani	Wahiawa	East Honolulu	Kaneohe	Kailua	Ko'olau Loa	North Shore	Wai'anae	Makiki–Mānoa	UH Mānoa	Ala Moana Center	*Total*
1	Downtown	24	40	69	222	6			47		6								4						2	12	34	***466***
2	Kaka'ako				9		9															3	3	2			22	***49***
3	Mō'ili'ili–Ala Moana	287	10	20	200	28			27		11									6			9			29	69	***695***
4	Waikīkī	850	191	559	646	831	179	281	800	16	314				519		19	34	819	30	320	67	154	13	90	172	4,498	***11,402***
5	Kaimukī–Wai'alae	8		15	19	21		8											12		34						12	***131***
6	Palama–Liliha	1	9	4	12		2	51	63	6	42				28				5							6	5	***232***
7	Kalihi–Iwilei	19			11					8									19				5				29	***90***
8	Airport–Pearl Harbor	99	47	9	136	182	148	6	251		90				8			0	2								95	***1,074***
9	Salt Lake–Āliamanu		600	16	20				2	5																	18	***661***
10	Pearl City–'Aiea	2			13		11	12	3		20									16							10	***87***
11	'Ewa	1			12					0											3							***15***
12	Kapolei					3	11						49															***62***
13	Makakilo												3															***3***
14	Waipahu–Waikele	45			8										196											66		***315***
15	Waiawa					9																						***9***
16	Mililani			17			4																					***21***
17	Wahiawa				3			17			21				19												39	***99***
18	East Honolulu	7	12	4	135	30		14	2										32		26				8		19	***290***
19	Kaneohe				5															9	19					3		***35***
20	Kailua		9		134			23	6										1	0	15						4	***193***
21	Ko'olau Loa								4						1					5		8	63				202	***282***
22	North Shore				6				4		2				12								5					***31***
23	Wai'anae				30			5	50		50		2											19				***155***
24	Makiki–Mānoa	30	5	60	52			30	65				2		56			4	5				17			11	13	***351***
25	UH Mānoa	17	6		94	7			14						32				6				18				51	***247***
26	Ala Moana Center	75									44															78		***197***
	Total	***1,466***	***930***	***773***	***1,769***	***1,116***	***363***	***447***	***1,337***	***35***	***599***	***0***	***56***	***0***	***872***	***0***	***19***	***38***	***905***	***65***	***418***	***78***	***275***	***34***	***99***	***377***	***5,121***	***17,193***

Table 3-63: Final Estimated Visitor Daily Transit Trips(P to A format)

		Downtown	Kaka'ako	Mō'ili'ili–Ala Moana	Waikīkī	Kaimukī–Wai'alae	Palama–Liliha	Kalihi–Iwilei	Airport–Pearl Harbor	Salt Lake–Āliamanu	Pearl City–'Aiea	'Ewa	Kapolei	Makakilo	Waipahu–Waikele	Waiawa	Mililani	Wahiawa	East Honolulu	Kaneohe	Kailua	Ko'olau Loa	North Shore	Wai'anae	Makiki–Mānoa	UH Mānoa	Ala Moana Center	*Total*
1	Downtown	-	-	71	22	10	-	1	12	-	1	-	-	-	-	-	-	-	3	-	-	-	2	-	2	-	17	***141***
2	Kaka'ako	-	-	-	-	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	***11***
3	Mō'ili'ili–Ala Moana	100	10	2	224	49	5	20	72	-	16	-	-	-	-	-	-	-	20	7	-	9	17	-	17	13	1	***582***
4	Waikīkī	1,839	206	655	1,107	1,208	253	471	1,151	12	270	-	-	-	523	-	19	33	711	34	326	140	191	12	439	191	4,351	***14,142***
5	Kaimukī–Wai'alae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	34	-	-	-	-	-	-	***34***
6	Palama–Liliha	-	-	4	-	-	-	42	63	6	-	-	-	-	28	-	-	-	-	-	-	-	-	-	-	-	-	***143***
7	Kalihi–Iwilei	-	-	-	3	-	-	-	1	8	-	-	-	-	-	-	-	-	19	-	-	-	-	-	-	-	5	***36***
8	Airport–Pearl Harbor	30	1	5	66	188	139	15	219	-	6	-	-	-	8	-	-	-	4	-	-	-	4	-	2	2	31	***720***
9	Salt Lake–Āliamanu	-	600	16	-	-	-	-	1	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***623***
10	Pearl City–'Aiea	4	-	-	5	-	12	2	2	-	10	-	-	-	-	-	-	-	-	16	-	-	-	-	-	-	9	***60***
11	'Ewa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	***3***
12	Kapolei	3	-	-	7	-	-	2	2	-	2	-	50	-	-	-	-	-	-	-	-	-	-	-	-	-	10	***76***
13	Makakilo	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***3***
14	Waipahu–Waikele	-	-	-	-	-	-	-	-	-	-	-	-	-	198	-	-	-	-	-	-	-	-	-	-	-	-	***198***
15	Waiawa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***0***
16	Mililani	-	-	18	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***21***
17	Wahiawa	-	-	-	-	-	-	-	-	-	-	-	-	-	19	-	-	-	-	-	-	-	-	-	-	-	1	***20***
18	East Honolulu	1	-	2	11	15	-	-	-	-	-	-	-	-	-	-	-	-	37	-	28	-	-	-	7	-	6	***107***
19	Kaneohe	2	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	19	-	-	-	-	-	-	***32***
20	Kailua	-	7	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	15	-	-	-	-	-	-	***23***
21	Ko'olau Loa	8	1	2	17	-	-	-	2	-	-	-	-	-	2	-	-	-	-	4	-	7	4	-	-	-	7	***54***
22	North Shore	-	-	-	-	-	-	-	4	-	-	-	-	-	12	-	-	-	-	-	-	-	-	-	-	-	-	***16***
23	Wai'anae	13	-	-	23	-	-	-	56	-	44	-	2	-	-	-	-	-	-	-	-	-	-	19	-	-	14	***171***
24	Makiki–Mānoa	2	-	60	5	-	-	29	61	-	-	-	2	-	59	-	-	3	2	-	-	-	16	-	-	-	6	***245***
25	UH Mānoa	-	-	-	-	-	-	-	-	-	-	-	-	-	34	-	-	-	-	-	-	-	-	-	-	-	-	***34***
26	Ala Moana Center	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	***0***
	Total	***2,002***	***825***	***835***	***1,492***	***1,470***	***421***	***582***	***1,647***	***32***	***349***	***0***	***57***	***0***	***883***	***0***	***19***	***36***	***796***	***70***	***425***	***156***	***234***	***33***	***467***	***206***	***4,458***	***17,495***

AR00040907

The final calibrated constants for the visitor model changed and are shown in Table 3-64 with the original constants.

Table 3-64: Visitor Model Constants

	New Constants	Old Constants
CONST(1)	-1.7234	-2.23384
CONST(2)	0.0503	-0.78665
CONST(3)	-2.314	-3.03093
CONST(4)	-2.8442	-3.80281
CONST(5)	-3.3582	-3.95056
CONST(6)	-2.0645	-2.71094
CONST(7)	-0.8021	-1.7637
CONST(8)	-1.5976	-2.43372
CONST(9)	-1.1318	-1.89066
CONST(10)	-0.8194	-1.78691
CONST(11)	-3.2842	-3.50003
CONST(12)	0.2492	-0.39423
CONST(13)	-2.2501	-3.18971
CONST(14)	-16.2452	-3.83589
CONST(15)	-0.951	-1.85926
CONST(16)	-1.3038	-2.21412
CONST(17)	-2.4871	-3.54949
CONST(18)	-1.0855	-2.32195
CONST(19)	-1.241	-2.18386
CONST(20)	-1.6053	-1.75141
CONST(21)	-4.2302	-4.6563
CONST(22)	-2.6279	-3.52679
CONST(23)	-2.9414	-3.84432
CONST(24)	0.596	0.44617
CONST(25)	-1.2073	-2.43219
KAUTO	-3.9871	-1.95361
KBUS	-5.759	-5.95
KRAIL	-5.759	-5.95
KTAXI	-6.5047	-6.2918
KTOUR	-5.6618	-4.53682
KWALK	2.8881	0
KWLKWAIKĪKĪ	1.7403	0
KTOURAM	-2.553	0
KWLKAM	-2.7798	0

3.2.3 Evaluation of Singly Constraining Shopping Purpose

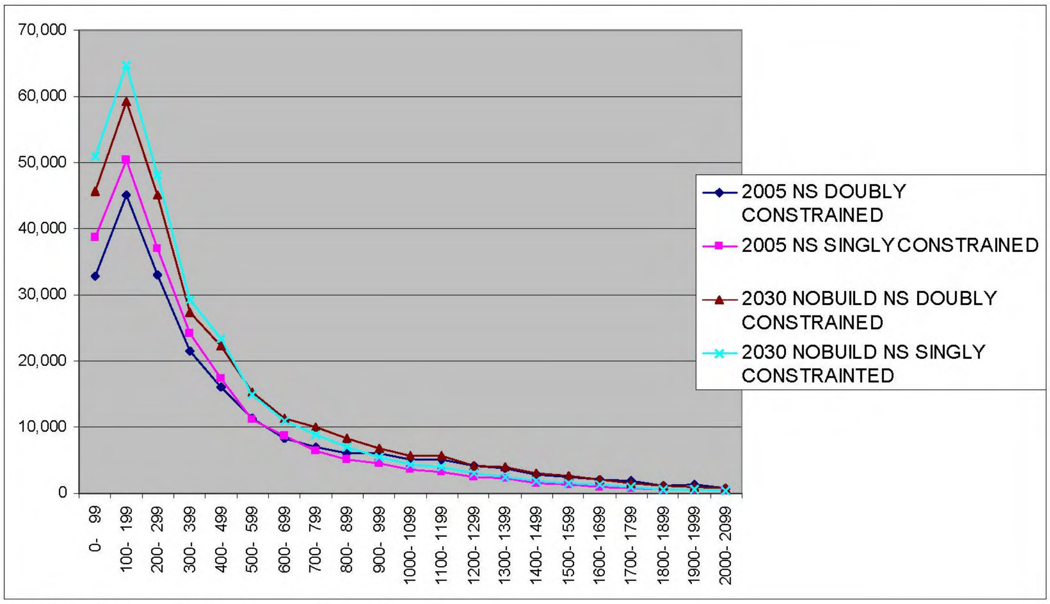
The survey for O‘ahu suggested a large number of transit trips at AMC. However, it was discovered that the model produced a lower number of person trips at Ala Moana than expected, resulting in an extremely high mode share. In an attempt to increase the person trips at AMC, singly constraining the shopping trips to attractions was tested.

Singly constraining reduced the number of trip attractions to AMC by 26%. If productions were balanced to that lower attraction number, it has the opposite effect that was desired. The 1995 HIS estimates attractions at 7.65% and the singly constrained would be 3% lower than the HIS—further showing that the singly constrained would not increase the person trips. Table 3-65 shows the district attractions to AMC for 1995 HIS and the singly versus doubly constrained totals

Table 3-65: AMC Comparison of Singly and Doubly Constrained

District		1995 HIS	Doubly	Singly
1	Downtown	433	285	236
2	Kaka'ako	396	604	563
3	Mō'ili'ili-Ala Moana	2937	3261	2615
4	Waikiki	3988	2200	1825
5	Kaimukī-Wai'alae	1081	1349	931
6	Palama-Liliha	1055	895	705
7	Kalihi-Iwilei	285	197	169
8	Airport-Pearl Harbor	0	31	26
9	Salt Lake-Āliamanu	428	212	184
10	Pearl City-'Aiea	372	237	121
11	'Ewa	52	141	29
12	Kapolei	0	32	10
13	Makakilo	159	42	13
14	Waipahu-Waikele	0	101	30
15	Waiawa	0	24	8
16	Mililani	0	103	34
17	Wahiawa	255	73	22
18	East Honolulu	436	775	461
19	Kaneohe	131	269	129
20	Kailua	218	320	167
21	Ko'olau Loa	0	26	16
22	North Shore	40	51	22
23	Wai'anae	777	246	48
24	Makiki-Mānoa	1408	2195	1780
25	UH Mānoa	0	114	84
26	Ala Moana Center	0	0	0
	Total	***14451***	***13783***	***10228***
	AMC Attraction %	7.65%	6.16%	4.57%
	Diff from Observed		1.49%	3.08%
	% Diff of Doubly versus Singly		-25.79%	

By singly constraining, the trip length was reduced by 1.27 miles in 2005 and .70 miles in 2030 when compared doubly constrained. The HIS trip length was 6.58 miles and, therefore, by singly constraining it moves further away from the observed data and this does not seem acceptable. Figure 3-46 shows the trips length distribution effects while Table 3-66 shows the actual distance results.



Note: NS = Non-work related Home Based Shopping

Figure 3-46: Trip Length Frequency Effects

Table 3-66: Trip Lengths for Different Year and Constraint Methods

Ave trip length	Dist (mi)
2030 No Build Singly	3.9609
2030 No Build Doubly	4.6592
2005 No Build Singly	4.0425
2005 No Build Doubly	5.3169
1995 HIS	6.58

Table 3-67 shows that 47 percent of the trips for shopping are intra-district trips in 2005. The HIS reported that 49 percent of all shopping trips were intra-district (Table 3-68). The doubly constrained method resulted in only 38 percent intra-district trips for 2005 as shown in Table 3-69. Singly constraining shopping does increase the number of intra-district trips by 19,000 in 2005 (Table 3-70) and 14,000 in 2030. The future year followed the same trend as 2005 but is not shown here. Although the singly constrained method improved intra-district trip distribution, the negative effects it had on total trip productions and attractions at AMC were not enough to change the shopping purpose to a singly constrained method.

Table 3-67: 2005 Singly Constrained Shopping Trips

		Downtown	Kaka‘ako	Mō‘ili‘ili–Ala Moana	Waikīkī	Kaimukī–Wai‘alae	Palama–Liliha	Kalihi–Iwilei	Airport–Pearl Harbor	Salt Lake–Āliamanu	Pearl City–‘Aiea	‘Ewa	Kapolei	Makakilo	Waipahu–Waikele	Waiawa	Mililani	Wahiawa	East Honolulu	Kaneohe	Kailua	Ko‘olau Loa	North Shore	Wai‘anae	Makiki–Mānoa	UH Mānoa	Ala Moana Center	*Total*
1	Downtown	985	583	289	0	156	267	797	60	78	62	0	0	0	6	0	1	1	10	9	9	0	1	0	27	29	236	***3606***
2	Kaka‘ako	163	808	343	0	95	43	122	12	21	13	0	0	0	3	1	0	0	4	2	2	0	0	0	13	20	563	***2228***
3	Mō‘ili‘ili–Ala Moana	340	1220	3715	0	1890	237	489	84	105	97	0	2	0	6	1	3	2	69	11	9	0	0	1	265	496	2615	***11657***
4	Waikīkī	124	655	1696	0	1486	81	188	34	43	43	0	0	0	3	0	0	2	27	12	7	1	0	1	94	170	1825	***6492***
5	Kaimukī–Wai‘alae	334	588	1483	0	8651	283	674	134	176	137	1	2	0	15	1	4	2	241	22	23	1	0	1	306	539	931	***14549***
6	Palama–Liliha	1288	987	891	0	736	3336	4208	703	1022	687	0	2	0	52	4	10	3	36	186	91	0	3	1	128	109	705	***15188***
7	Kalihi–Iwilei	430	271	213	0	204	482	2806	310	398	224	0	3	0	13	2	4	1	7	30	12	0	0	0	28	26	169	***5633***
8	Airport–Pearl Harbor	35	29	40	0	39	55	360	918	490	455	1	2	0	26	5	4	5	3	10	2	0	0	1	6	4	26	***2516***
9	Salt Lake–Āliamanu	218	193	226	0	224	358	1803	2018	5059	2645	2	8	1	145	20	26	19	17	73	28	0	2	1	28	44	184	***13342***
10	Pearl City–‘Aiea	127	130	137	0	154	198	859	566	1392	13335	11	68	11	1399	152	242	99	10	53	32	1	6	5	22	19	121	***19149***
11	‘Ewa	22	33	38	0	43	32	154	145	207	1498	4550	545	67	4257	104	199	87	11	23	15	4	6	15	6	3	29	***12093***
12	Kapolei	7	7	10	0	11	11	48	40	63	473	137	1947	167	969	35	60	26	4	5	4	0	1	40	1	2	10	***4078***
13	Makakilo	10	10	15	0	18	13	49	48	64	391	58	981	897	726	29	54	25	6	10	9	1	3	22	4	0	13	***3456***
14	Waipahu–Waikele	42	32	41	0	46	45	238	248	368	2493	99	273	40	7886	310	495	157	3	19	12	2	5	17	6	6	30	***12913***
15	Waiawa	10	6	14	0	9	12	64	62	95	673	6	23	0	1159	345	374	87	2	6	3	1	2	2	1	2	8	***2966***
16	Mililani	25	32	32	0	35	33	170	162	238	2498	13	58	6	1742	591	6079	2052	4	19	18	2	31	6	4	5	34	***13889***
17	Wahiawa	17	14	18	0	29	19	67	65	91	714	7	30	5	497	151	1318	5009	2	13	13	3	78	4	5	2	22	***8193***
18	East Honolulu	189	328	695	0	4523	171	409	85	135	104	1	3	0	21	1	8	5	5650	26	150	2	3	1	158	226	461	***13355***
19	Kaneohe	149	154	139	0	156	294	736	216	329	378	2	5	1	49	10	12	5	11	9782	1146	6	3	2	19	26	129	***13759***
20	Kailua	192	200	156	0	176	198	346	80	133	169	0	6	2	34	5	8	7	91	1272	11068	1	8	3	23	24	167	***14369***
21	Ko‘olau Loa	9	12	18	0	22	10	34	16	24	36	2	7	1	16	3	8	7	6	114	22	2443	18	3	6	0	16	***2853***
22	North Shore	11	24	24	0	35	10	45	33	39	126	3	13	5	90	23	150	507	8	18	20	142	3315	7	5	3	22	***4678***
23	Wai‘anae	21	31	28	0	62	17	79	59	65	224	24	633	51	298	16	36	26	14	31	27	6	9	8078	7	6	48	***9896***
24	Makiki–Mānoa	740	1497	2732	0	1480	581	985	169	221	177	1	3	0	13	1	3	1	68	32	37	0	3	1	1180	360	1780	***12065***
25	UH Mānoa	28	54	171	0	261	28	57	12	13	13	0	0	0	1	0	0	0	7	1	1	0	0	0	37	103	84	***871***
26	Ala Moana Center	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	***0***
	Total	***5516***	***7898***	***13164***	***0***	***20541***	***6814***	***15787***	***6279***	***10869***	***27665***	***4918***	***4614***	***1254***	***19426***	***1810***	***9098***	***8135***	***6311***	***11779***	***12760***	***2616***	***3497***	***8212***	***2379***	***2224***	***10228***	***223794***

Table 3-68: Household Interview Survey Shopping Purpose

		Downtown	Kaka'ako	Mō'ili'ili–Ala Moana	Waikīkī	Kaimukī–Wai'alae	Palama–Liliha	Kalihi–Iwilei	Airport–Pearl Harbor	Salt Lake–Āliamanu	Pearl City–'Aiea	'Ewa	Kapolei	Makakilo	Waipahu–Waikele	Waiawa	Mililani	Wahiawa	East Honolulu	Kaneohe	Kailua	Ko'olau Loa	North Shore	Wai'anae	Makiki–Mānoa	UH Mānoa	Ala Moana Center	*Total*
1	Downtown	1140	0	130	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	***1728***
2	Kaka'ako	0	784	441	0	0	0	330	0	400	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	396	***2351***
3	Mō'ili'ili–Ala Moana	661	690	4367	0	459	0	575	0	0	260	0	0	0	199	0	0	0	50	0	0	0	0	0	88	393	2937	***10679***
4	Waikīkī	150	0	4576	381	552	0	0	0	156	0	0	0	0	309	0	62	0	140	0	0	0	0	0	205	512	3988	***11031***
5	Kaimukī–Wai'alae	653	1324	1123	0	9676	124	205	387	39	155	0	0	0	0	0	0	0	175	0	0	0	0	0	78	61	1081	***15081***
6	Palama–Liliha	1606	56	642	0	333	3685	2656	146	65	258	0	0	0	89	0	63	0	259	23	0	0	0	0	38	84	1055	***11058***
7	Kalihi–Iwilei	1011	0	0	0	0	0	1182	0	253	0	0	0	0	0	0	0	0	0	0	273	0	0	0	0	0	285	***3004***
8	Airport–Pearl Harbor	0	0	0	0	0	0	0	1281	588	1203	0	0	0	0	0	0	0	0	90	0	0	0	0	0	0	0	***3162***
9	Salt Lake–Āliamanu	0	0	133	0	295	162	466	1126	6537	2361	0	0	0	1092	0	220	0	0	0	0	0	0	0	0	0	428	***12820***
10	Pearl City–'Aiea	393	0	703	0	468	625	1003	707	608	14005	0	175	0	169	0	0	0	0	0	0	0	0	0	0	0	372	***19228***
11	'Ewa	134	0	0	0	0	0	0	953	488	147	847	182	0	1820	0	0	383	0	0	0	0	0	0	0	0	52	***5006***
12	Kapolei	0	0	0	0	0	0	0	0	45	45	0	57	0	426	0	0	0	0	0	0	0	0	0	0	0	0	***573***
13	Makakilo	0	0	0	0	0	0	0	0	35	0	0	1148	0	535	0	0	0	0	0	0	0	0	0	0	0	159	***1877***
14	Waipahu–Waikele	0	0	0	0	0	0	0	0	332	1526	0	0	0	5698	715	0	0	0	0	0	0	0	0	0	0	0	***8271***
15	Waiawa	0	0	0	0	0	0	0	0	0	686	0	0	0	1205	882	260	0	0	0	0	0	0	0	0	0	0	***3033***
16	Mililani	327	0	0	0	0	0	0	417	262	2718	0	0	0	1679	0	3406	980	0	0	0	0	0	364	0	49	0	***10202***
17	Wahiawa	0	0	0	0	76	0	114	0	377	784	0	0	0	234	0	596	5175	0	0	0	0	0	0	0	0	255	***7611***
18	East Honolulu	160	77	267	0	2994	0	0	0	0	0	0	0	0	0	0	0	0	7940	177	199	0	0	0	87	82	436	***12419***
19	Kaneohe	0	0	0	0	0	56	56	60	571	0	0	0	0	154	0	0	0	171	8140	606	0	0	0	0	0	131	***9945***
20	Kailua	45	35	0	42	35	0	0	47	268	0	0	0	0	109	0	188	0	311	2090	10032	0	0	0	0	0	218	***13420***
21	Ko'olau Loa	0	0	0	0	0	0	0	0	0	0	0	0	0	140	0	0	0	0	57	0	3946	75	0	0	0	0	***4218***
22	North Shore	0	0	0	0	0	0	0	0	77	527	0	0	0	0	0	605	502	0	0	0	0	1017	0	0	0	40	***2768***
23	Wai'anae	0	75	0	0	0	0	0	34	0	829	0	332	0	0	0	1020	0	0	0	0	0	0	4705	0	0	777	***7772***
24	Makiki–Mānoa	1238	800	3403	131	413	160	415	126	213	349	0	0	0	45	0	0	0	69	0	0	0	0	0	2065	494	1408	***11329***
25	UH Mānoa	74	45	77	0	107	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	45	0	***363***
26	Ala Moana Center	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	***0***
	Total	***7592***	***3886***	***15862***	***554***	***15408***	***4812***	***7027***	***5284***	***11314***	***25853***	***847***	***1894***	***0***	***13903***	***1597***	***6420***	***7040***	***9115***	***10577***	***11110***	***3946***	***1092***	***5069***	***2576***	***1720***	***14451***	***188949***

AR00040912

Table 3-69: 2005 Doubly Constrained Shopping Trips

		Downtown	Kaka'ako	Mō'ili'ili–Ala Moana	Waikīkī	Kaimukī–Wai'alae	Palama–Liliha	Kalihi–Iwilei	Airport–Pearl Harbor	Salt Lake–Āliamanu	Pearl City–'Aiea	'Ewa	Kapolei	Makakilo	Waipahu–Waikele	Waiawa	Mililani	Wahiawa	East Honolulu	Kaneohe	Kailua	Ko'olau Loa	North Shore	Wai'anae	Makiki–Mānoa	UH Mānoa	Ala Moana Center	*Total*
1	Downtown	891	743	234	0	113	211	849	100	88	28	0	1	0	2	0	0	0	5	1	5	0	0	0	33	17	285	***3606***
2	Kaka'ako	146	915	277	0	60	25	122	15	23	6	0	0	0	1	0	0	0	3	1	1	0	0	0	16	13	604	***2228***
3	Mō'ili'ili–Ala Moana	340	1556	3152	0	1475	182	550	133	133	55	0	0	0	2	1	0	0	52	7	7	0	0	0	315	436	3261	***11657***
4	Waikīkī	122	829	1415	0	1245	67	197	62	50	21	0	1	0	0	0	0	1	19	6	3	0	0	0	110	144	2200	***6492***
5	Kaimukī–Wai'alae	372	883	1380	0	7697	251	850	254	234	91	0	3	0	6	0	1	2	217	8	10	0	0	0	427	514	1349	***14549***
6	Palama–Liliha	1216	1340	729	0	546	2641	4599	1193	1225	368	0	4	0	14	1	3	1	29	85	48	0	0	0	148	103	895	***15188***
7	Kalihi–Iwilei	400	353	170	0	146	350	2889	493	437	110	0	3	0	4	0	0	1	9	16	4	0	0	0	30	21	197	***5633***
8	Airport–Pearl Harbor	25	34	25	0	23	33	323	1335	456	206	0	0	0	4	2	0	1	1	4	4	1	0	0	6	2	31	***2516***
9	Salt Lake–Āliamanu	195	251	178	0	168	254	1872	3163	5436	1424	0	8	1	39	6	9	1	9	31	17	0	1	0	33	34	212	***13342***
10	Pearl City–'Aiea	185	278	192	0	182	241	1528	1577	2415	11101	2	60	4	730	93	112	39	17	50	21	3	7	1	48	26	237	***19149***
11	'Ewa	80	143	102	0	117	92	585	867	814	2252	2001	680	61	3651	118	155	86	14	40	31	7	11	2	28	15	141	***12093***
12	Kapolei	19	32	22	0	22	23	141	210	206	569	38	1826	100	705	27	44	19	7	8	8	1	1	9	6	3	32	***4078***
13	Makakilo	22	44	28	0	36	26	148	208	194	485	14	948	607	518	25	34	21	7	12	11	4	4	4	9	5	42	***3456***
14	Waipahu–Waikele	75	123	81	0	92	93	668	1052	1022	2785	36	313	31	5711	252	294	96	4	28	18	0	7	6	16	9	101	***12913***
15	Waiawa	17	30	21	0	16	23	170	264	261	730	0	26	1	819	281	215	45	4	7	4	0	2	0	3	3	24	***2966***
16	Mililani	73	106	85	0	81	74	532	798	804	3257	4	84	7	1437	561	4392	1351	10	25	26	3	46	0	19	11	103	***13889***
17	Wahiawa	42	72	52	0	56	50	253	364	356	1068	0	51	2	462	164	1084	3815	6	18	17	7	146	3	18	14	73	***8193***
18	East Honolulu	245	585	764	0	4377	170	608	215	207	68	0	2	1	10	2	3	6	4636	17	141	2	1	0	264	256	775	***13355***
19	Kaneohe	235	357	209	0	199	386	1385	593	677	351	0	4	0	24	7	7	4	17	7881	1055	13	1	0	51	34	269	***13759***
20	Kailua	299	433	232	0	200	278	602	242	252	149	0	5	0	13	4	9	3	75	976	10191	3	1	0	49	33	320	***14369***
21	Ko'olau Loa	10	27	20	0	20	11	53	42	35	24	1	5	0	6	1	3	2	4	77	15	2444	14	2	9	2	26	***2853***
22	North Shore	19	50	34	0	39	18	91	107	87	118	2	17	4	50	16	88	244	10	12	22	205	3375	0	12	7	51	***4678***
23	Wai'anae	95	215	152	0	195	80	419	494	403	534	10	1577	104	405	25	43	37	44	63	93	23	32	4516	60	31	246	***9896***
24	Makiki–Mānoa	677	1919	2200	0	1067	470	1060	268	261	85	0	0	0	5	1	1	0	48	12	21	0	0	0	1454	321	2195	***12065***
25	UH Mānoa	32	73	146	0	212	20	68	17	20	7	0	0	0	0	0	0	0	4	1	2	0	0	0	52	103	114	***871***
26	Ala Moana Center	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	***0***
	Total	***5832***	***11391***	***11900***	***0***	***18384***	***6069***	***20562***	***14066***	***16096***	***25892***	***2108***	***5618***	***923***	***14618***	***1587***	***6497***	***5775***	***5251***	***9386***	***11775***	***2716***	***3649***	***4543***	***3216***	***2157***	***13783***	***223794***

Table 3-70: Increase in Trips using Singly Constrained

		Downtown	Kaka‘ako	Mō‘ili‘ili–Ala Moana	Waikīkī	Kaimukī–Wai‘alae	Palama–Liliha	Kalihi–Iwilei	Airport–Pearl Harbor	Salt Lake–Āliamanu	Pearl City–‘Aiea	‘Ewa	Kapolei	Makakilo	Waipahu–Waikele	Waiawa	Mililani	Wahiawa	East Honolulu	Kaneohe	Kailua	Ko‘olau Loa	North Shore	Wai‘anae	Makiki–Mānoa	UH Mānoa	Ala Moana Center	*Total*
1	Downtown	94	(160)	55	0	43	56	(52)	(40)	(10)	34	0	(1)	0	4	0	1	1	5	8	4	0	1	0	(6)	12	(49)	***0***
2	Kaka‘ako	17	(107)	66	0	35	18	0	(3)	(2)	7	0	0	0	2	1	0	0	1	1	1	0	0	0	(3)	7	(41)	***0***
3	Mō‘ili‘ili–Ala Moana	0	(336)	563	0	415	55	(61)	(49)	(28)	42	0	2	0	4	0	3	2	17	4	2	0	0	1	(50)	60	(646)	***0***
4	Waikīkī	2	(174)	281	0	241	14	(9)	(28)	(7)	22	0	(1)	0	3	0	0	1	8	6	4	1	0	1	(16)	26	(375)	***0***
5	Kaimukī–Wai‘alae	(38)	(295)	103	0	954	32	(176)	(120)	(58)	46	1	(1)	0	9	1	3	0	24	14	13	1	0	1	(121)	25	(418)	***0***
6	Palama–Liliha	72	(353)	162	0	190	695	(391)	(490)	(203)	319	0	(2)	0	38	3	7	2	7	101	43	0	3	1	(20)	6	(190)	***0***
7	Kalihi–Iwilei	30	(82)	43	0	58	132	(83)	(183)	(39)	114	0	0	0	9	2	4	0	(2)	14	8	0	0	0	(2)	5	(28)	***0***
8	Airport–Pearl Harbor	10	(5)	15	0	16	22	37	(417)	34	249	1	2	0	22	3	4	4	2	6	(2)	(1)	0	1	0	2	(5)	***0***
9	Salt Lake–Āliamanu	23	(58)	48	0	56	104	(69)	(1145)	(377)	1221	2	0	0	106	14	17	18	8	42	11	0	1	1	(5)	10	(28)	***0***
10	Pearl City–‘Aiea	(58)	(148)	(55)	0	(28)	(43)	(669)	(1011)	(1023)	2234	9	8	7	669	59	130	60	(7)	3	11	(2)	(1)	4	(26)	(7)	(116)	***0***
11	‘Ewa	(58)	(110)	(64)	0	(74)	(60)	(431)	(722)	(607)	(754)	2549	(135)	6	606	(14)	44	1	(3)	(17)	(16)	(3)	(5)	13	(22)	(12)	(112)	***0***
12	Kapolei	(12)	(25)	(12)	0	(11)	(12)	(93)	(170)	(143)	(96)	99	121	67	264	8	16	7	(3)	(3)	(4)	(1)	0	31	(5)	(1)	(22)	***0***
13	Makakilo	(12)	(34)	(13)	0	(18)	(13)	(99)	(160)	(130)	(94)	44	33	290	208	4	20	4	(1)	(2)	(2)	(3)	(1)	18	(5)	(5)	(29)	***0***
14	Waipahu–Waikele	(33)	(91)	(40)	0	(46)	(48)	(430)	(804)	(654)	(292)	63	(40)	9	2175	58	201	61	(1)	(9)	(6)	2	(2)	11	(10)	(3)	(71)	***0***
15	Waiawa	(7)	(24)	(7)	0	(7)	(11)	(106)	(202)	(166)	(57)	6	(3)	(1)	340	64	159	42	(2)	(1)	(1)	1	0	2	(2)	(1)	(16)	***0***
16	Mililani	(48)	(74)	(53)	0	(46)	(41)	(362)	(636)	(566)	(759)	9	(26)	(1)	305	30	1687	701	(6)	(6)	(8)	(1)	(15)	6	(15)	(6)	(69)	***0***
17	Wahiawa	(25)	(58)	(34)	0	(27)	(31)	(186)	(299)	(265)	(354)	7	(21)	3	35	(13)	234	1194	(4)	(5)	(4)	(4)	(68)	1	(13)	(12)	(51)	***0***
18	East Honolulu	(56)	(257)	(69)	0	146	1	(199)	(130)	(72)	36	1	1	(1)	11	(1)	5	(1)	1014	9	9	0	2	1	(106)	(30)	(314)	***0***
19	Kaneohe	(86)	(203)	(70)	0	(43)	(92)	(649)	(377)	(348)	27	2	1	1	25	3	5	1	(6)	1901	91	(7)	2	2	(32)	(8)	(140)	***0***
20	Kailua	(107)	(233)	(76)	0	(24)	(80)	(256)	(162)	(119)	20	0	1	2	21	1	(1)	4	16	296	877	(2)	7	3	(26)	(9)	(153)	***0***
21	Ko‘olau Loa	(1)	(15)	(2)	0	2	(1)	(19)	(26)	(11)	12	1	2	1	10	2	5	5	2	37	7	(1)	4	1	(3)	(2)	(10)	***0***
22	North Shore	(8)	(26)	(10)	0	(4)	(8)	(46)	(74)	(48)	8	1	(4)	1	40	7	62	263	(2)	6	(2)	(63)	(60)	7	(7)	(4)	(29)	***0***
23	Wai‘anae	(74)	(184)	(124)	0	(133)	(63)	(340)	(435)	(338)	(310)	14	(944)	(53)	(107)	(9)	(7)	(11)	(30)	(32)	(66)	(17)	(23)	3562	(53)	(25)	(198)	***0***
24	Makiki–Mānoa	63	(422)	532	0	413	111	(75)	(99)	(40)	92	1	3	0	8	0	2	1	20	20	16	0	3	1	(274)	39	(415)	***0***
25	UH Mānoa	(4)	(19)	25	0	49	8	(11)	(5)	(7)	6	0	0	0	1	0	0	0	3	0	(1)	0	0	0	(15)	0	(30)	***0***
26	Ala Moana Center	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	***0***
	Total	***-316***	***-3493***	***1264***	***0***	***2157***	***745***	***-4775***	***-7787***	***-5227***	***1773***	***2810***	***-1004***	***331***	***4808***	***223***	***2601***	***2360***	***1060***	***2393***	***985***	***-100***	***-152***	***3669***	***-837***	***67***	***-3555***	***0***

3.2.4 Trip Generation Model—Ala Moana Factor

During investigations of observed versus estimated transit ridership to AMC, it was discovered that the 2005 O'ahu travel demand model under-estimated trip attractions to AMC compared to the expanded 1995 home-interview survey data, the Institute of Transportation Engineers (ITE) trip generation rates for shopping malls (Figure 3-47), and AMC's marketing materials.

AMC is Hawai'i's largest shopping center and is the largest open-air shopping center in the world. It has over 260 luxury brand shops, local specialty stores, fine-dining restaurants, and an international food court in over 1.8 million square feet of gross leasable area (GLA). It is also a key transfer terminal for TheBus and, as a result, attracts a relatively high share of bus trips.

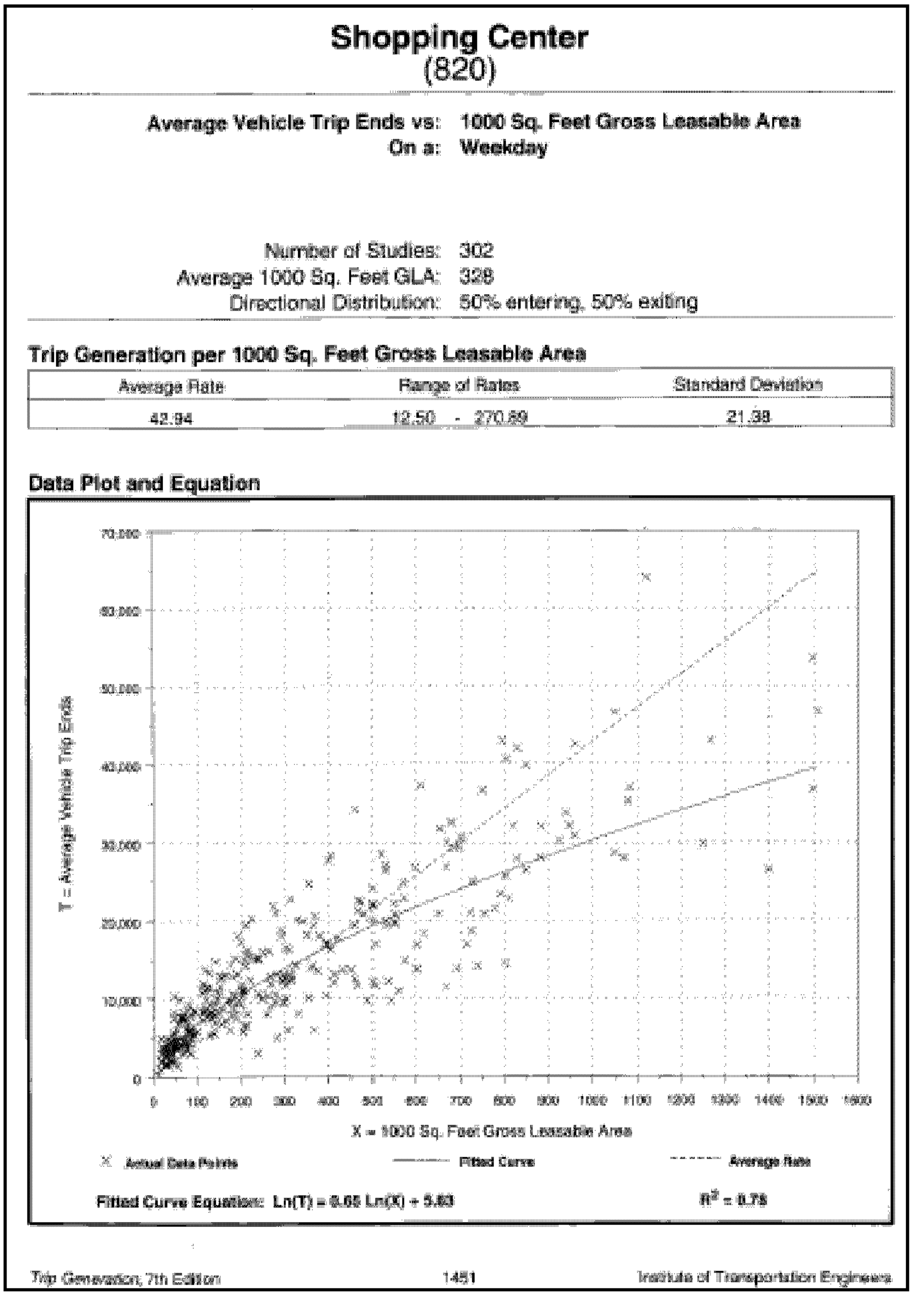
2005 estimated trip attractions from the travel demand model were compared to 1995 home-interview survey trip attractions to AMC, and it was discovered that the 2005 model attracted significantly less trips to Ala Moana than the 1995 data (despite the expansion of AMC from 1.5 to its current 1.8 million square feet of GLA in 1999). The 1995 data suggests that the shopping center attracted over 46,000 resident person trips, while the 2005 initial model attracted only 27,000 resident person trips (Table 3-71).

The ITE trip attraction rates for shopping malls indicate that approximately 60,000 trip attractions should be generated by a mall with 1.8 million square feet of GLA, calculated by interpolating between a straight-line calculation of 42.94 trips per 1,000 feet of GLA and the fitted curve equation $\ln(T)=0.65 * \ln(X) + 5.83$. It is assumed that the ITE rates pertain only to resident travel and that visitor travel is unique to AMC. Finally, AMC marketing materials suggest that they receive over 100,000 visitors per day, although this data has not been verified.

A further investigation of trip attraction rates for AMC indicates that the shopping center is treated as a typical trip attractor in the core area type, with the lowest trip attraction rates of any area type (1.7 home-based-shop trips per retail employee, for example). Given its unique nature, AMC should be treated as a special generator with specific trip attraction rates. Therefore, the trip attraction model was modified to factor up the estimated trip attractions, primarily in the home-based-shop and home-based-other (HBO) trip purposes, in order to match approximately 60,000 total attractions in 2005. The final estimated 2005 attractions are also given in Table 3-71.

Table 3-71: Ala Moana Center Resident Person Trip Attractions

Trip Purpose	Trip Attractions		
	1995 HIS	2005 Initial Estimated	2005 Final Estimated
Home-based-work	7,233	5,474	8,222
Home-based-other	23,446	11,630	35,033
Non-home-based-work	5,635	4,583	6,353
Non-home-based-other	9,882	5,445	10,011
Total	***46,196***	***27,132***	***59,619***



Shopping Center
(820)

Average Vehicle Trip Ends vs: 1000 Sq. Feet Gross Leasable Area
On a: Weekday

Number of Studies: 302
Average 1000 Sq. Feet GLA: 328
Directional Distribution: 50% entering, 50% exiting

Trip Generation per 1000 Sq. Feet Gross Leasable Area

Average Rate	Range of Rates	Standard Deviation
42.94	12.50 - 270.89	21.39

Data Plot and Equation

Fitted Curve Equation: $Ln(T) = 0.65\ Ln(X) + 5.83$ $R^2 = 0.78$

Trip Generation, 7th Edition 1451 Institute of Transportation Engineers

Figure 3-47: ITE Trip Attraction Rates for Shopping Centers

3.3 Mode Choice Adjustments

Figure 3-48 shows the model nesting structure. The model has a traditional nesting structure, with transit access nested below the overall transit mode. Line-haul modes of local, premium (i.e., express), and guideway, if available, are nested below walk-access while PNR and kiss-and-ride modes, regardless of line-haul mode, are nested below drive-access. A recent addition to this structure, not shown, is the addition of toll and non-toll choices below the single-occupant vehicle (SOV), 2 occupant, and 3+ occupant auto modes.

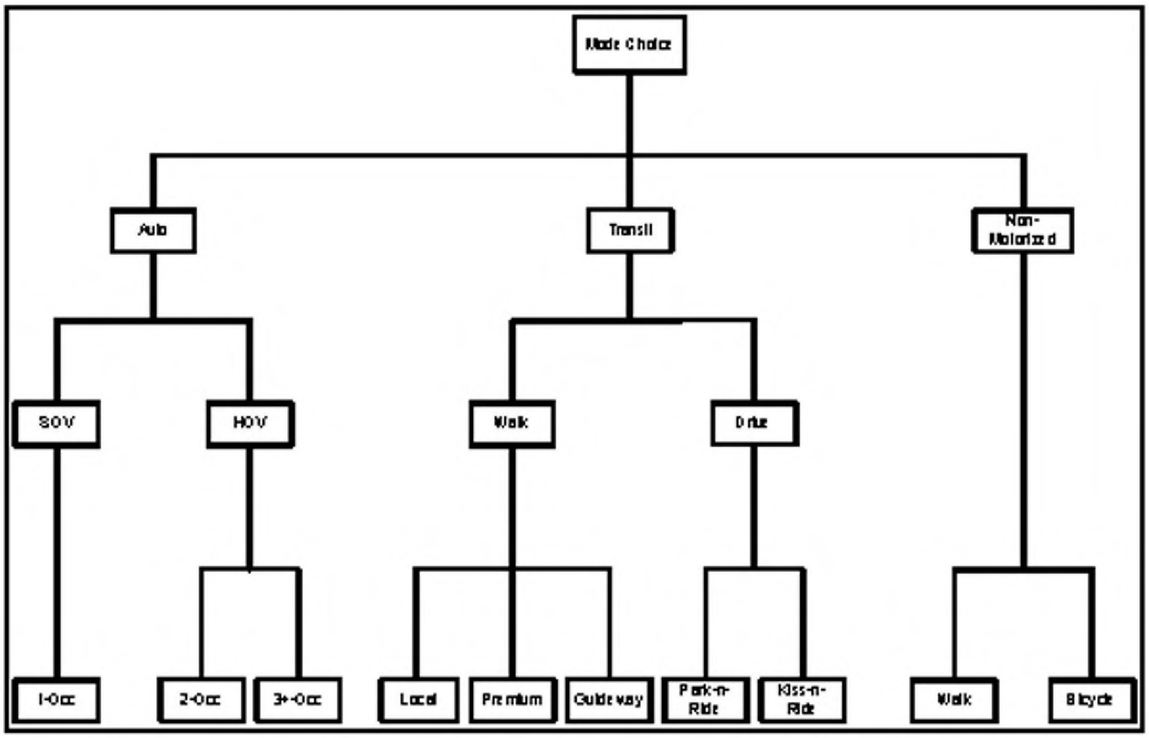


Figure 3-48: O'ahuMPO Mode Choice Model Nesting Structure

3.3.1 Adjustment of Mode Choice Model

The mode choice model was re-calibrated as part of the 2005 base year model development process. The calibration results are discussed later in the report. There are several adjustments that were made to the mode choice model, and they are discussed briefly in the list below:

- Removal of the requirement for non-zero attraction end parking cost for PNR—previously the model would not allow consideration of PNR use if the parking cost at the destination end was zero. This has been removed to allow any destination.
- Removal of the maximum drive time ratio threshold for PNR access—previously the drive time for PNR could not exceed one-third of the transit IVT, otherwise, the PNR mode was not allowed. Now, a function is used to penalize longer drive

access trips, with no penalty if the ratio of drive time to total IVT is less than one-quarter. Beyond this, there is a linear penalty added, with a maximum (drive time/total IVT = 1.0) of about 27 minutes. In addition, the minimum drive time threshold was removed. Note that a restriction preventing PNR transit trips with a production end in the CBD remains.

- Non-motorized travel is now allowed for intra-zonal interchanges—previously the auxiliary mode (i.e., non-motorized) skim generation did not calculate intra-zonal times, leaving them at 0. The mode choice model recognizes this as an unconnected interchange, and no non-motorized trips are estimated. As a corollary to this change, the auxiliary skims were also limited to 30 minutes for both walk (at 3 mph) and bike (at 7 mph). All valid non-motorized interchanges are now included in the skims, though the mode choice model can be used to limit the maximum time. Non-motorized trips longer than 30 minutes are, however, a very small share of total non-motorized trips. The intrazonal restriction is much more significant, especially for home-based-school, home-based-college, home-based-other, and home-based-shopping trips. The greater market for non-motorized trips permits much more reasonable constants for bike and non-motorized travel in the new calibrated model.
- The geography stratification has been modified so that the user may exclude its use through keyword specification—this is the default condition and has been used for the initial model re-calibration. In addition, if the geography stratification is used, it will be applied only at the top (auto, transit, non-motorized) level through separate constants stratified by area and mode, but not jointly stratified (as before) with auto ownership. This allows direct observation of the nature of the geography-based constants, if they are employed.
- Though not affecting the model calculations, two summary reports have been added to the model report file. Report 1 gives the market, trips, and market share for each mode by auto ownership. This is a very useful report for evaluating the adequacy of the market for a particular mode. Report 2 gives the same market share information by distance for each transit mode.
- The self-calibration module was modified to be compatible with the new constants, and user options allow for “freezing” or turning off the calibration of geography constants, KNR, and drive-access constants.
  - Short Transit Trip Penalty—a transit distance penalty for short transit trips was introduced so that people were less likely to take short transit trips.
  - District-Specific Constants
    - Transit trips to Downtown were under-estimated by 23 percent; half of this under-estimate is due to journey-to-work—home-based-work (JTW-WH) trips and half is due to home-based-other trips (which is under-estimated by 40 percent to Downtown). Both under-estimates are fairly evenly distributed across all production districts.

- Transit trips to AMC were under-estimated by 54 percent (-9,000), despite matching visitor trips to AMC nearly perfectly and the increase in total attractions to AMC through adjustments to the trip attraction model. Two-thirds of this under-estimate is due to a lack of home-based-other trips. The skims to AMC are reasonable. Some interchanges were debugged and a conclusion was drawn that the mode choice model does not see the advantage of taking transit to shop at AMC. The bus-alternative-specific constant is so highly negative for shop and other non-work purposes that level-of-service does not have much of an effect on the utility of transit. It is suspected that many of the OBS trips are "pass-through" transit trips where someone is on his/her way back from work, transferring at Ala Moana, and stopping off for a bite to eat or to do some quick shopping. The model just does not understand this behavior. Implied mode shares (calculated using the estimated total attractions and the observed transit on-board trips) suggest 33 percent of home-based-work (HBW) and home-based-other trips use bus to get to AMC, which is not unreasonable.

Both of these major observations strongly suggest adding attraction district constants for Downtown and AMC for both journey-to-work—home-based-work and home-based-other trip purposes. It is doubtful that all of the AMC trips are accurate in reporting their true attraction.

Therefore, district constants for AMC (attractions-District 26) and Waikīkī (productions-District 4) were added—a set of production and attraction district factors as well as for the Downtown CBD.

The factors are specified at the multinomial level and scaled appropriately in the program and are applied to all transit modes.

- **Toll Changes—**incorporated the Nimitz Flyover toll options from the previous work by implementing the CLSTollDA and CLSTollSR nesting coefficients, set the toll time savings and distance parameters to 0, and set the toll cost to the asserted values from the Nimitz Flyover work. The Kocc3 constant was scaled to compensate for the changed nesting coefficients so that the model would replicate the previously calibrated shared 2 and 3+ shares.
- **Noprem Option—**there was a parameter called *noprem* which turns off premium transit. This was being used in a strange way for drive-transit trips, since these alternatives do not distinguish between transit line-haul modes. Two more options—nopnr and noknr—were created which can be turned off to prevent drive-transit trips for some particular purpose. The old parameter now only controls premium walk-access trips.
- **Trip Table Scaling—**added a parameter called *scale* which controls the precision of the output trip tables. Scale can be set to any integer number 1, 10, 100, etc.

The IVT for the journey-to-work purposes (and home-based-college) is low at -0.0185, and an asserted value of -0.0250 was suggested. Similarly, the remaining non-work purposes (except for home-based-school [K-12]) are adjusted from -0.0181 to -0.02 for journey-at-work (JAW) and -0.0100 for non-work-related purposes. Adjustments were also made to reflect a 2:1 ratio for walk and initial wait time relative to IVT for all purposes where previously the wait time was 3 to 4 times the IVT. The cost coefficient for journey-to-work and home-based-college was set to reflect a $3.57 average hourly value of time (VOT). The non-work-related cost coefficient was set at twice the journey-to-work cost coefficient, and the journey-at-work cost coefficient was set at 1.2 times the journey-to-work coefficient. This leads to a VOT for journey-at-work and non-work-related purposes of $0.71.

Transit transfer time penalties, originally in the Honolulu High Capacity Transit Corridor Project Alternative Analysis (AA) phase at the equivalent of 6 wait time minutes, were adjusted down for journey-to-work and home-based-college purposes to 2.48 minutes.

Wait time was originally not stratified in the AA phase, but a separate short initial wait coefficient equivalent to 2 times the IVT coefficient should be used for the first 5 minutes of the initial wait time and all subsequent transfer wait times. A lower value, equal to the IVT coefficient, should be used for the portion of the initial wait time longer than 5 minutes.

3.3.2 Implementation of New Informal Park-and-Ride and Kiss-and-Ride Process

There are two types of transit parking lots available in Honolulu—formal lots, provided by the transit agency, and informal lots, which includes both on-street parking and other lots not owned by the agency. The original O‘ahu mode choice model structure did not allow competition between formal and informal lots; if a zone was connected to a formal lot, it assumed that all PNR trips would utilize that lot, while only zones that were unconnected to a formal lot were allowed to consider parking at an informal lot.

Therefore, the model was extended to reflect the choice between formal and informal PNR. The nesting coefficient for the PNR choice nest is 0.75. The informal lot utility is based on the KNR skim, which is basically the best walk-transit path, but with drive time substituting for walk-access time on the production end of the trip. In order to prevent identification problems between formal PNR and informal PNR (which could happen when the KNR lot is the same as the PNR lot), the informal PNR lot choice is turned off when the formal and informal PNR skimmed IVT, first wait, and transfer wait times are exactly the same.

In the future, formal PNR lots will provide better access to the rail stations and will be better policed. Therefore, the size of this constant should be further analyzed and perhaps reduced in magnitude or offset by a formal constant to reflect changes in the unobserved attribute.

The KNR process also needed to be addressed because all the KNR trips were being assigned to walk-to-transit paths. In addition, the KNR skim is being set to formal PNR skim in cases where there is a valid walk path and no formal PNR path. This occurs because the formal path has a lower generalized cost (since it is zero) than the walk path, so KNR is basically turned off for the interchange. Therefore, the only time that KNR/informal PNR is available is when formal PNR is also available, or when the walk-converted-to-drive skim has a total weighted time of over 99 minutes (due to a condition that is incorrectly set), meaning KNR is turned off for interchanges where formal PNR is not available.

The first issue was addressed by sorting all KNR and informal PNR trip tables into one of two bins—either a walk-converted-to-drive bin or a formal PNR bin—based on which path was selected for the KNR skims. The walk-converted-to-drive bin was assigned to the walk network. The formal PNR bin trips get assigned to the formal PNR networks. The skimming process for KNR was changed to allow KNR anywhere there is a valid path, not just a formal PNR path. Appendix A has a sample of the original and revised work purpose PNR and KNR control files which show the implemented changes.

3.3.3 Implementation and Testing of a Toll Choice Component for the Mode Choice Model

Introduction

The capability to test toll facilities was not included in the original model and, as there were and are no toll facilities on O‘ahu, there was no opportunity to gather data to support such a model. However, some options in the regional transportation plan included a toll facility, and future planning may include investigations into tolling options. Therefore, the capability of estimating toll demand was added to the mode choice model to facilitate current and future planning needs.

This section discusses the theoretical approach to toll modeling, the implementation of the toll estimation capability in the O‘ahuMPO regional model, and a summary of the adjustment and sensitivity testing that was done, using a toll test case.

Model Theory

There are two competing approaches to modeling toll road demand within the context of a regional planning model. In one approach, toll facility use is considered a route choice, conducted after the traveler chooses a private auto, either as driver or passenger. In this approach, the “cost” of using a toll facility is included in a generalized cost assignment routine, and vehicles are routed on or off toll links according to the equilibrium assignment parameters. In the second approach, used in this application, use or non-use of a toll facility is considered a sub-mode choice to auto modes. Implementing this approach means modifying the mode choice model to allow for a new nest below drive-alone, 2, and 3+ person auto modes. One way in which to differentiate these approaches is by the basic assumption they make about the decision process of travelers who use toll facilities. A *tactical* decision during the trip, where the auto traveler decides to use a toll facility because of the immediate perceived traffic conditions would be best modeled by an assignment-based process. A *strategic* decision, made routinely by the auto traveler in anticipation of the perceived costs prior to the trip would be more in line with treatment as a mode, and therefore implemented in the mode choice model. In truth, there are probably elements of both of these behaviors present in the traveling public. The strategic model of toll choice behavior was selected since it offers the advantage of a logic-based decision model and can incorporate behavioral differences, such as VOT, evident in socio-economic and trip purposes.

Based on past experience, there are several variables that influence toll use. We have used the following in our O‘ahuMPO model implantation:

- **Toll Cost**—the monetary cost (in cents) of using a “toll-preferred” path.
- **Distance on Toll Facility**—the distance (in miles) of toll lanes used along the “toll-preferred” path. This variable allows a greater benefit for longer toll-facility trips, which presumably saves more time. It also discourages paths that might jump on and off toll barrier-free toll facilities for short distances.
- **Time Savings**—the time (in minutes) that is saved by the “toll-preferred” path over the non-toll path. Toll facilities are built to provide a time savings over parallel congested paths, so this time savings from toll lane use is an important variable.
- **Additional Distance**—with the same weight as the toll distance, this variable is the additional distance (if any) used by the toll-preferred path over the non-toll path and discourages unreasonable toll paths. This also serves to counterbalance the toll lane distance variable so that only the net distance saved/expended becomes important.

Implementation

There are two primary aspects to the toll choice implantation. First, the proper level of service variables, such as toll time, distance, and cost, must be generated from the highway network, along with the standard variables. Second, the mode choice model itself must be modified to accept these new toll variables and implement them in a new toll/non-toll nest.

Toll Level-of-service Variable Generation

The analysis of toll facilities using the O‘ahuMPO regional travel demand model requires some revisions to the highway network link attributes, the highway path building procedures, and highway network building/unbuilding steps. The resulting level of service matrices now includes both toll and non-toll paths, as well as toll distance and toll cost for the toll paths. Non-toll paths exclude all toll links, while toll paths include all allowable toll links for a given vehicle assignment class. No *a priori* weighting is done to favor toll facilities.

In order to accommodate tolls on regular toll facilities, as well as other occupancy-stratified tolls, such as may be used on high-occupancy toll (HOT) lanes, three additional link attributes have been added. These link attributes are:

- toll1—toll, in cents, assessed all drive-alone vehicles crossing a link
- toll2—toll, in cents, assessed all 2-person occupancy vehicles crossing a link
- toll3—toll, in cents, assessed all 3+ person occupancy vehicles crossing a link

For regular toll facilities, toll1, toll2, and toll3 will be identical. However, this structure does allow for differential tolls by occupancy that might apply for HOT lane facilities.

Though transparent to the user, three additional link attributes are also created within the highway skim procedure. These are tdist1, tdist2, and tdist3 and are used to sum toll lane distance for drive-alone, 2-person, and 3+ person occupancy autos.

The other coding change that the user must include is to specify the type of facility. This is done through the use of the limita, limitm and limitp link attributes (the “a,” “m,” and “p” refer to AM peak, midday or off-peak, and PM peak, respectively). In addition to the standard values, three additional values have been added—10, 11, and 12.

Limita, limitm, and limitp values:

- Open to all vehicles
- Single occupancy vehicles and trucks are prohibited (i.e., HOV 2+ lanes)
- Single occupancy vehicles, 2-person autos and trucks are prohibited (i.e., HOV 3+ lanes)
- Bus- and transit-only links
- Bus/transit/bike and walk links
- Trucks prohibited
- Walk- and bike-only links
- Usually used to show roadway links needed for transit but not highway (transit-support links)
- Undefined
- Traditional toll, all vehicles tolled, including HOT lanes where all vehicles have some toll
- HOT lane where drive-alone vehicles pay and 2 and 3+ person autos are free
- HOT lane where drive-alone and 2-person autos pay and 3+ person autos are free

Therefore, by careful combinations of the limita, limitm, and limitp values and specification of toll1, toll2, and toll3, the user can specify almost any combination of regular and HOT lane tolls. The use of toll-lane distance offers somewhat less flexibility, since only a fixed, per-mile toll rate may be applied by auto occupancy category.

Revised Highway Skims

The revised level of service matrices that are produced are expanded from two to six tables for each skim type. The following tables are now produced by the highway skim procedures, as shown in Table 3-72. Tables 1 and 2 remain the same.

Table 3-72: O'ahuMPO Regional Model Highway Skims (with toll paths)

Table	Description
1	Time, non-toll path (minutes)
2	Distance, non-toll path (miles)
3	Time, toll path (minutes)
4	Distance, toll path (miles)
5	Distance on toll facilities, along toll path (miles)
6	Toll on toll path (cents), derived from toll1, toll2, and toll3 link attributes

The number of highway level of service files, and their names, remain the same. These files are:

skpkxx01.<alt>—peak drive-alone
skpkxx02.<alt>—peak 2-person autos
skpkxx03.<alt>—peak 3+ person autos
skopxx01.<alt>—off-peak drive-alone
skopxx02.<alt>—off-peak 2-person autos
skopxx03.<alt>—off-peak 3+ person autos

The change to the network and highway skim files also includes changes to the following control files:

Hwybld/data/ubldlink.set
Hwy/atrhwy.set
Hwy/skttxxau.set
Fdb/atrhwy.set
Fdb/atrhwyop.set
Fdb/skttxxau.set

In addition, the “makeclas” and “feedback” programs will need to be revised to accommodate the toll1, toll2, and toll3 attributes.

Note that the toll skim tables are always produced but will be populated with 0 if no toll facilities are designated in the network.

Mode Choice Model Changes

The mode choice model was modified to calculate toll utilities for drive-alone, 2-person, and 3+ person auto modes. These utilities were identical to those of the corresponding non-toll equations, with the following terms added:

C_{tsav}*Toll Time Savings +
C_{tdst}*Toll Road Distance +
C_{tout}*Toll Path Excess Distance +
C_{toll}*Toll Cost

In addition, the toll/non-toll nest level has a logsum coefficient.

A logical parameter in the control file (tollmdl) is used to direct the model on whether or not to use the toll nest.

Finally, a new output table is produced which includes toll and non-toll auto trips. The tables are:

drive alone non-toll trips
drive alone toll trips
2-person non-toll trips
2-person toll trips
3-person non-toll trips
3-person toll trips

Adjustment

Since there is no available observed data for toll behavior, a strict calibration of the parameters is not possible. The values of C_{tsav}, C_{tdst}, C_{tout} and C_{toll}, as well as the toll nest logsum coefficient, are borrowed from the toll model used in Houston by the Houston-Galveston Council of Governments. However, the C_{toll} value should be related to the implied VOT, which varies by trip purpose. Consequently, a sensitivity analysis was conducted using the hypothetical tolled tunnel in Pearl Harbor, to examine the response of the mode choice model to changes in the value of the toll cost coefficient, C_{toll}. Figure 3-49 shows the toll demand as a function of the cost coefficient. The graph in Figure 3-49 shows that for reasonable VOT of $10/hour to $20/hour there is little variation in demand. A toll VOT of $15 was used in the Houston-Galveston Council of Governments model, so this value is used for the O‘ahuMPO model.

Since the VOT varies somewhat by trip purpose, the C_{toll} value will also change. The final coefficient values are:

C_{tsav} = +0.271
C_{toll} = -0.00074 (purposes wh,ww,wo,wn and nc—JTW and College)
C_{toll} = -0.00072 (purposes ns,no,nn,aw,an—non-work related and JAW)
C_{toll} = -0.00044 (purposes nk—HBK-12)
C_{tout} = -0.070
C_{tdst} = +0.070
C_{lstoll} = 0.50 (toll nest logsum coefficients)

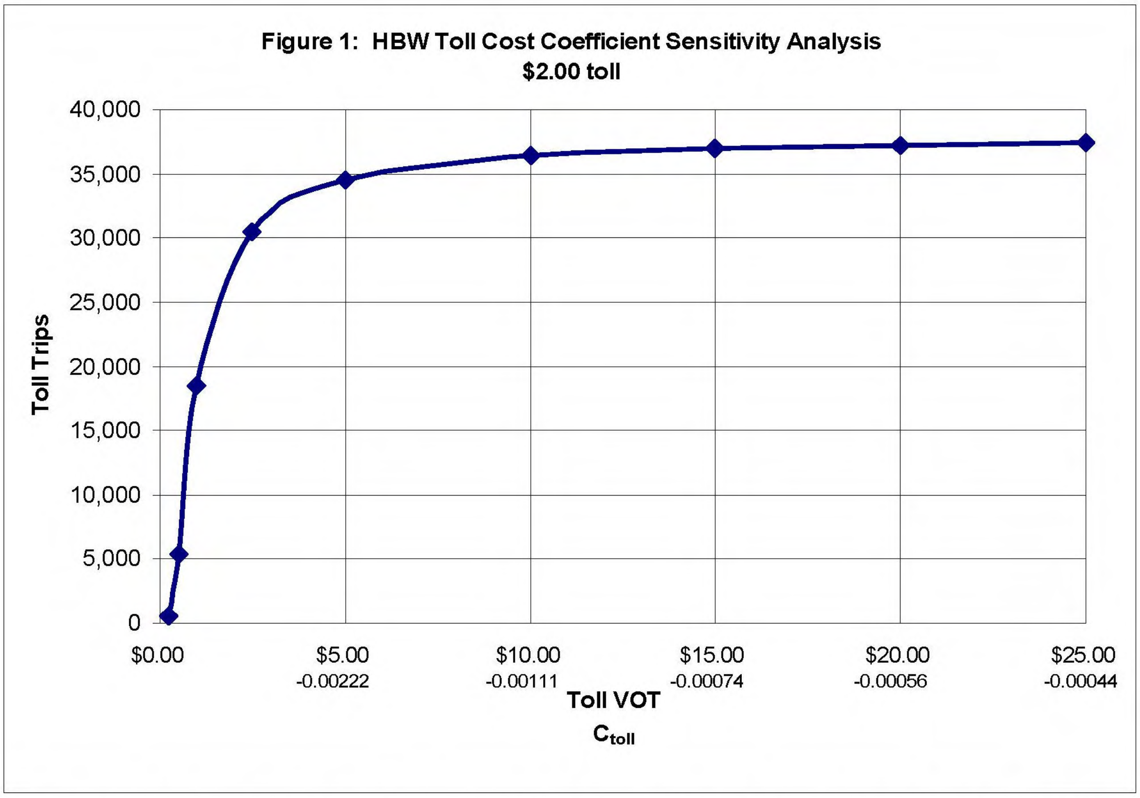


Figure 3-49: Home-based-work Toll Cost Coefficient Sensitivity Analysis $2.00 Toll

3.4 Update to Walk Access Links Process

3.4.1 Drivelinks Revisions

The model uses a program to determine drive access links (DRVLINKS). The program determines the zones that are within a specified distance (5 miles originally) to PNR locations and generates a list of potential access links that satisfy that distance. It provides access to an unlimited number of connections to PNR locations and allows people to travel long distances thus passing closer PNR locations. The list of generated access links was also placed in a sorted list by station node number. If a zone was only allowed three drive links, it took the first three links in the list or the links that had the lowest station number, which doesn't correlate to the shortest links that a zone may have access to. Therefore, people wanting to use a PNR may have to travel a longer path due to this limitation, when in fact closer locations existed. The drive access link process did not allow for informal PNR access either. On O'ahu, many transit riders park in neighborhoods and businesses, creating informal PNR locations, but DRVLINKS was not allowing this option.

Another issue concerned the PNR text file that is created to allow MINUTP to create the access links to the stations (bus and rail). DRVLINKS output a file that listed a range of zones for MINUTP to use for bus PNR, like zone 1-764. The MINUTP program cannot handle ranges that large because of memory limitations, and it forces the program to shut down. Previously, a smaller range, 1–100, had to be manually inserted into this file so that it could operate. A similar issue occurred for the rail stations—it only provided a possible range of zones but did designate which ones truly could be physically connected within the 5-mile link limitation. That also does not show exactly which zones have access to the correct station locations, since a driver is not going to travel 15 miles to the PNR from the other side of the island. The old method does not guarantee that between alternatives that the same access links are being consistently generated. Previously the rail station file looked like this:

```
$**** coding for station UH-WO **************
    noza 4502
    xy 4502,10518,5266
    xy 4602,10518,5266
    xy 4702,10518,5266
    wacc 4602-4502,.20
    pnr 4702-4502,$=47.02,t=.20,441-764
    link 3892-4502,3,3.00
    xfer 3892-4502
```

And the bus PNR locations were listed as:

```
$**** coding for bus PnR HawaiiKai **************
    pnr 2643,$=26.43,t=.20,1-764
```

The revised code gives distinct zones so that consistency is met and so that the program can function properly. Here is the same rail station coding under the new process and it clearly shows the zones that are possible for link access.

```
$**** coding for station UHWO‘ahu **************
    noza 4503
    xy 4503,10357,5868
    xy 4603,10357,5868
    xy 4703,10357,5868
    wacc 4603-4503,.20
    pnr 4703-4503,$=47.03,t=.20
    PNR Z=384,388-395,397-401,404,407-413,418-438,440-472
    PNR Z=476-491,499,501-506,539-628,763-764
    link 3895-4503,3,3.00
    xfer 3895-4503
```

The new bus PNR looks like this:

```
$**** coding for bus PnR HawaiiKai **************
    pnr 2643,$=26.43,t=.20
    PNR Z=1-131,133-177,179-181,191,279-280,282-283,729
    PNR Z=735-754,756-761
```

Every alternative was tested to assure that the same access was provided at the stations to ensure ridership access consistency with this new code revision.

Several other changes were made to alleviate the drive access issues.

- Drive access length increased from 5 to 8 miles. The transit OBS suggested people were driving longer than 5 miles on average, so it was changed to a longer reasonable length as designated by the survey responders (changed in the ALAMXXTR.ctl, ALMDXXTR.ctl informal and formal file).
- Max Station/Max Bus option had to be restricted. This option in MINUTP allows zones only to connect to limited bus and rail stations instead of allowing people to drive long unrealistic distances to PNR formally/informally. It selects the best/shortest options for connections based on the access link list that is generated by the access program mentioned previously. MINUTP had memory storage issues associated with trying to connect and process all the links in the file. Each alternative tested resulted in different connector/memory issues so, in order to be consistent, the number of access links was limited in all the alternatives to the same value. For the informal PNR skimming process, the limits were set to maxstations=4 and maxbus=3 so the alternatives would be comparable. The formal PNR did not cause a problem and, therefore, unlimited connections were allowed. This change occurs in the alltransitlinesDrvI.ctl file.
- A change was made to the program to sort the list of access links by shortest distance. Previously the links that met the distance criteria were listed in the output file but were not in any particular order. That means that if one zone had 6 possible links that could provide access, records would look like this (trnDrvi_xx.out file):

```
link 0435-2004,306,20.0
link 0435-4708,141,20.0
link 0435-3648,297,20.0
link 0435-4738,166,20.0
link 0435-4709,178,20.0
link 0435-3990,141,20.0
link 0435-2571,479,20.0
```

When this file was used in the MINUTP program and link connections are limited to four, it would have selected the first four links as access links (highlighted in yellow). The first four links in this file are not the four shortest access links and so improper access was being generated, thus the paths to transit could be represented as longer. The longer length affects the mode choice decision of travelers and resulted in incorrect ridership. By sorting by shortest distance before sending this file to MINUTP it now ensures that the proper links are chosen when connections are limited in MINUTP control files

3.4.2 Manual Adjustment of Walk Access Links

The program used to generate the walk access to transit links (ACCLINK) is an intelligent way to assure the best links are used for transit service access. ACCLINK uses a weighting/ranking procedure to determine which nodes on the network have the best transit access. It then attaches walk access links (a specified limit on the number of connections for each zone) from each zone to the nodes that have the best service.

Service frequency along routes is the main indicator of which nodes have higher scores and thus get connected to walk access links. One unintended problem with the method was discovered when comparing the Transportation System Management (TSM) and Build Alternatives. A large amount of negative benefits were showing up between zone pairs that were relatively close, 20 to 30 minutes walking time between the zones.

In the TSM, a particular node was not scored high using the program because other nodes had better transit access; therefore, the node was not connected with a walk link. The same node in the Build Alternatives version had the rail line crossing it, thus increasing service frequency, or in some cases nodes had a slight bus route change that caused the node to be scored higher. Since this node was now ranked higher in the Build Alternatives, then both zones could now be connected to that node. Both nodes connected to the same node allowed people to walk through that node to get between the zone pair. Since walking between the zone pair was slightly faster than the TSM Alternative, it had no transit path in the Build Alternatives . In the TSM, a transit path was used, but a transit path was not used in the Build Alternatives, so it resulted in negative benefits for that zone pair.

Instances like this had to be manually adjusted in either the TSM or Build Alternatives to assure that the same walk through occurred in both options. A list of common occurring walk connections was created and inserted into the walk access link file for both the AM and midday link files (eg:alamxxtr.msl) for each option. Table 3-73 shows the links that were manually edited and which network was corrected.

Table 3-73: Manual Adjustments to Walk Links

Zone	Connection Node	Network Changed	Action to Link	Time Period Changed
71	1201	MOSL	added	peak
66	1181	MOSL	added	peak
600	3892	TSM	added	peak
600	3895	TSM	added	peak
358	1739	TSM	added	peak
500	2566	TSM	added	peak
212	3281	TSM	added	peak
199	3281	TSM	added	peak
610	2542	TSM	added	peak
355	1754	TSM	added	peak
145	1174	TSM	added	peak
498	2566	TSM	added	peak
373	2002	TSM	added	peak
199	1342	MOSL	deleted	peak
311	1716	MOSL	added	peak
479	3990	TSM	added	peak
474	3990	TSM	added	peak
373	1903	TSM	added	peak
382	1861	TSM	added	midday
433	3990	TSM	added	midday
438	3990	TSM	added	midday
373	2002	TSM	added	midday
479	3990	TSM	added	midday
474	3990	TSM	added	midday
613	4022	TSM	added	midday
586	4022	TSM	added	midday
587	4022	TSM	added	midday
584	4022	MOSL	delete	midday
585	4022	MOSL	delete	midday
478	3990	TSM	added	midday
273	1416	TSM	added	midday

3.4.3 MINUTP Access Link Limitations

MINUTP builds the walk access links during the skimming process. However, due to memory limitation, it can only handle a certain number of access links. The KNR skimming process (which determines the informal PNR) created many links because most of the transit nodes were available for walk access connection. The memory issue in MINUTP forced the program to shut down when it had too many possible access connections from each zone. In order to assure consistent operation and output from the model for each option, the number of walk access connections to express bus and limited stop (shown in bold below) had to be reduced from 6 to 5 in the KNR skims.

Here is the code in the SKAMW1KR.set file to change the access:

zacc ,,,8-200,**5-200,5-200**,,6-200 build walk-access links

3.5 Other Changes

3.5.1 TAZ and District Change

The original model had a 762-zone system and 25-district system. The zone system was increased to 764 zones to accommodate changes in the landscape. These additional zones allowed for better communication of data by the travel demand model. Figure 3-50 shows the original zone boundaries, designated by thick black lines and black numbers. Zone 604 was split to better represent the UH West O‘ahu campus in the future by providing better public transportation connection access to the UH campus. In the new zone system, zone 604 now represents the actual UH campus and zone 763 represents the residential development surrounding the campus.

Originally zone 600, the Ho‘opili area, was a zone that covered a large area. In order to accommodate the future development expectations in this zone and to provide the proper roadway access to the Ho‘opili area, it was important to split this zone into zone 600, designated in pink, and zone 764, designated in peach. A few additional adjustments to zone boundaries were made at this time as well, in order to better represent the travel patterns in this area. None of these boundary changes affected the housing and employment control totals for the model. The original data was re-allocated to the zones accordingly.

The district system was also increased from 25 to 26 districts so that AMC became its own district. This allows for easier analysis of the trips, boardings, and benefits directly related to AMC.

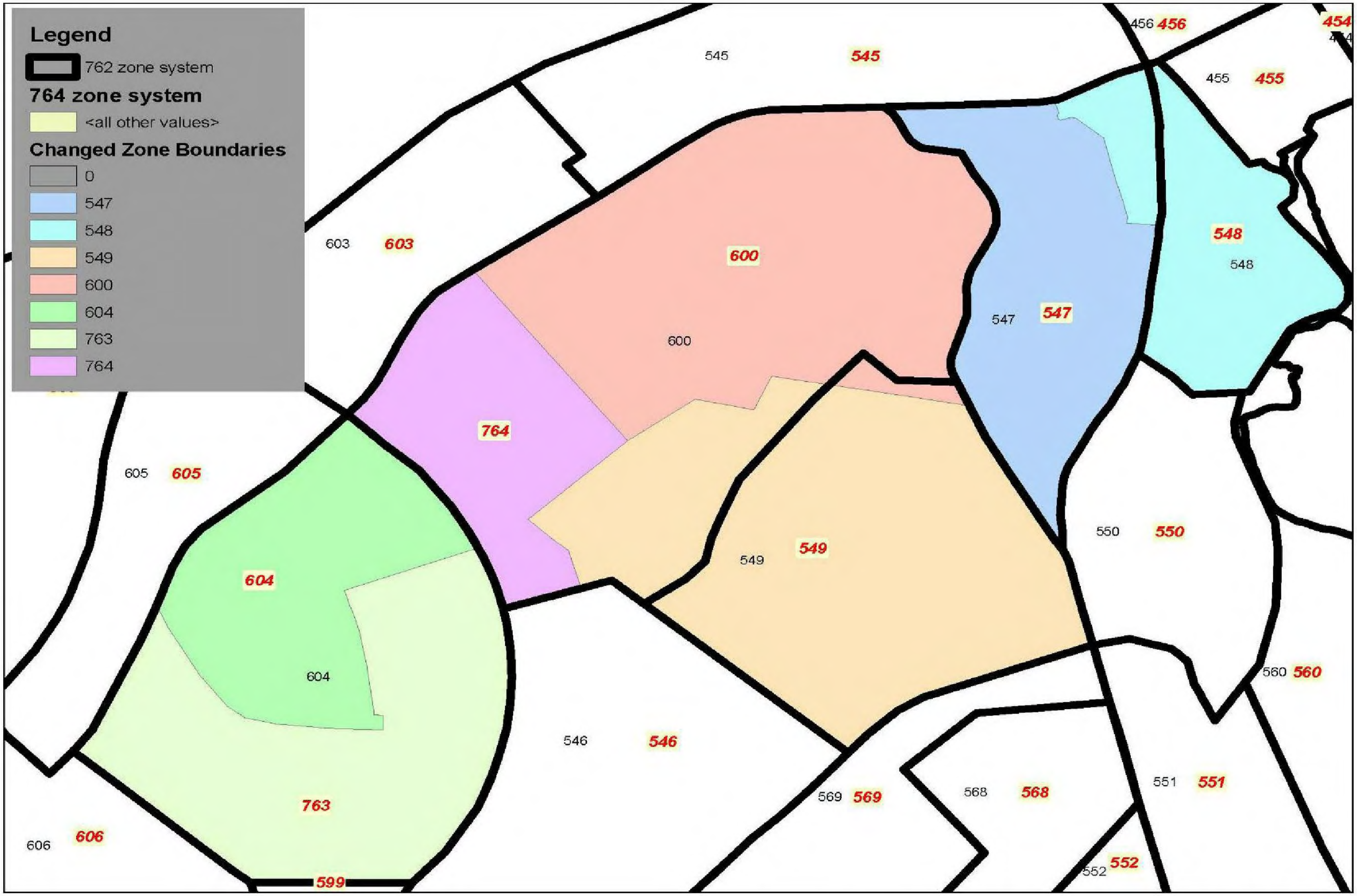


Figure 3-50: Model Zone Boundary Changes

AR00040932

3.5.2 Land Use Changes

The allocation of land use on O‘ahu has changed dramatically since the November 2006 AA submittal. Although the control totals remained consistent, the distribution of employment and households changed for various reasons. Table 3-74 shows the difference in population, households, and employment by district for the November 2006 AA submittal and the current land-use data.

One of the largest changes in the 2005 base year was the allocation of military employment. Previously, a majority of the island’s military employment was improperly allocated to the Salt Lake district instead of being allocated to the actual places of work at other military installations on the island. Almost 10,000 jobs were removed from Salt Lake as part of this re-distribution, and districts like Mililani (Schofield Barracks) and Pearl Harbor gained employment.

Another major change in land-use was a decrease in both visitor and residential units in the Waikīkī area. This change is due to the conversion of residential units to visitor units and some major demolition and reconstruction that occurred in Waikīkī in 2005. Future changes carried these trends forward but also allowed for the City’s policy change in allowing more residential development in Waiawa and Mililani and less in ‘Ewa/Kapolei.

The future year data shows a general trend of increase in most districts for both population and employment. The largest growth in households is seen in the Kaka‘ako, ‘Ewa, Kapolei, and Wahiawa districts, with each having more than 11,000 new households in the future. Kapolei also has the highest employment growth of over 37,000 new employees. Most of this tremendous growth is near the proposed rail alignment. Table 3-75 shows the change in population, households, and employment by district between 2005 and 2030. Figure 3-51 shows the island-wide household growth from 2005 to 2030, while Figure 3-52 shows the employment growth between the same time period.

Table 3-74: Land Use Comparison to Last Model Calibration

Transit District	2005 AA Population	2005 DEIS Population	2005 Population Difference	2005 AA Households	2005 DEIS Households	2005 Households Difference	2005 AA Employment	2005 DEIS Employment	2005 Employment Difference
1. Downtown	12,557	12,730	173	6,451	6,564	113	63,607	64,684	1077
2. Kaka'ako	7,183	7,674	491	3,793	4,083	290	25,119	24,780	(339)
3. Mō'ili'ili / Ala Moana	40,223	40,301	78	21,048	21,167	119	34,907	36,665	1758
4. Waikīkī	21,843	20,902	(941)	12,821	12,301	(520)	47,477	46,456	(1021)
5. Kaimukī / Wai'alae	55,402	55,302	(100)	20,247	20,287	40	19,769	21,219	1450
6. Palama / Liliha	65,298	65,174	(124)	19,503	19,544	41	17,898	18,153	255
7. Kalihi / Iwilei	25,701	25,721	20	7,383	7,413	30	39,096	42,278	3182
8. Airport / Pearl Harbor	11,620	11,587	(33)	3,120	3,121	1	37,030	39,729	2699
9. Salt Lake / Āliamanu	54,649	54,465	(184)	17,484	17,490	6	44,012	34,044	(9968)
10. Pearl City / 'Aiea	79,146	78,909	(237)	25,096	25,114	18	23,865	24,910	1045
11. 'Ewa	51,911	51,587	(324)	14,579	14,524	(56)	8,242	8,195	(47)
12. Kapolei	16,164	16,718	554	4,674	4,833	159	17,286	17,349	63
13. Makakilo	15,783	15,710	(73)	4,669	4,659	(10)	2,039	1,998	(41)
14. Waipahu / Waikele	56,749	56,628	(121)	14,907	14,906	(1)	15,347	15,552	205
15. Waiawa	12,223	12,195	(28)	4,017	4,014	(3)	4,957	4,294	(663)
16. Mililani	53,802	53,685	(117)	17,784	17,783	(1)	12,478	17,972	5494
17. Wahiawā	36,580	36,510	(70)	10,472	10,471	(1)	23,306	18,020	(5286)
18. East Honolulu	49,776	49,748	(28)	17,275	17,303	28	6,858	6,931	73
19. Kāne'ohe	54,925	54,809	(116)	17,153	17,152	(1)	12,263	12,121	(142)
20. Kailua	64,078	63,954	(124)	18,635	18,635	(0)	23,877	24,019	142
21. Ko'olau Loa	14,728	14,697	(31)	3,648	3,646	(2)	5,833	5,883	50
22. North Shore	18,437	18,395	(42)	6,191	6,190	(1)	4,000	3,909	(91)
23. Wai'anae	43,196	44,656	1460	10,789	11,933	1144	6,890	7,253	363
24. Makiki / Mānoa	45,050	44,980	(70)	19,519	19,564	45	7,651	7,668	17
25. UH Mānoa	5,880	5,873	(7)	1,435	1,439	4	13,029	12,889	(140)
26. Ala Moana Center	3	3	0	2	2	(0)	6,237	5,880	(357)
Total	***912,907***	***912,913***	***6***	***302,695***	***304,135***	***1440***	***523,073***	***522,851***	***(222)***

*This table compares the base year land use from the November 2006 AA submittal to the current land use revisions used in the Draft EIS

Table 3-75: 2005 versus 2030 Land Use Comparison

Transit District	2005 DEIS Population	2005 DEIS Households	2005 DEIS Employment	2030 DEIS Population	2030 DEIS Households	2030 DEIS Employment	Population Change	Households Change	Employment Change
1. Downtown	12730	6564	64684	22933	12380	70945	10203	5817	6261
2. Kaka'ako	7674	4083	24780	33745	19386	34128	26071	15304	9348
3. Mō'ili'ili / Ala Moana	40301	21167	36665	48817	26723	42967	8516	5556	6302
4. Waikīkī	20902	12301	46456	22869	13965	49432	1967	1665	2976
5. Kaimukī / Wai'alae	55302	20287	21219	57774	22035	24382	2472	1748	3163
6. Palama / Liliha	65174	19544	18153	67859	21414	21160	2685	1871	3007
7. Kalihi / Iwilei	25721	7413	42278	33986	10224	47995	8265	2811	5717
8. Airport / Pearl Harbor	11587	3121	39729	12473	3573	40871	886	452	1142
9. Salt Lake / Āliamanu	54465	17490	34044	53784	18018	35033	(681)	528	989
10. Pearl City / 'Aiea	78909	25114	24910	79119	26328	30968	210	1214	6058
11. 'Ewa	51587	14524	8195	91215	27595	15516	39628	13072	7321
12. Kapolei	16718	4833	17349	56261	17301	54420	39543	12467	37071
13. Makakilo	15710	4659	1998	29550	9126	3434	13840	4467	1436
14. Waipahu / Waikele	56628	14906	15552	61277	17563	20375	4649	2657	4823
15. Waiawa	12195	4014	4294	45552	15129	10356	33357	11114	6062
16. Mililani	53685	17783	17972	53602	19171	19789	(83)	1389	1817
17. Wahiawā	36510	10471	18020	35186	10818	19511	(1324)	346	1491
18. East Honolulu	49748	17303	6931	51304	19191	6795	1556	1889	(136)
19. Kāne'ohe	54809	17152	12121	53529	18058	12726	(1280)	907	605
20. Kailua	63954	18635	24019	63147	19744	24772	(807)	1109	753
21. Ko'olau Loa	14697	3646	5883	16516	4438	6945	1819	791	1062
22. North Shore	18395	6190	3909	20750	7236	4355	2355	1046	446
23. Wai'anae	44656	11933	7253	52285	14207	7126	7629	2274	(127)
24. Makiki / Mānoa	44980	19564	7668	47692	21671	9197	2712	2108	1529
25. UH Mānoa	5873	1439	12889	6094	1627	13503	221	188	614
26. Ala Moana Center	3	2	5880	3	2	6010	0	0	130
Total	***912,913***	***304,135***	***522,851***	***1,117,322***	***396,925***	***632,711***	***204,409***	***92,791***	***109,860***

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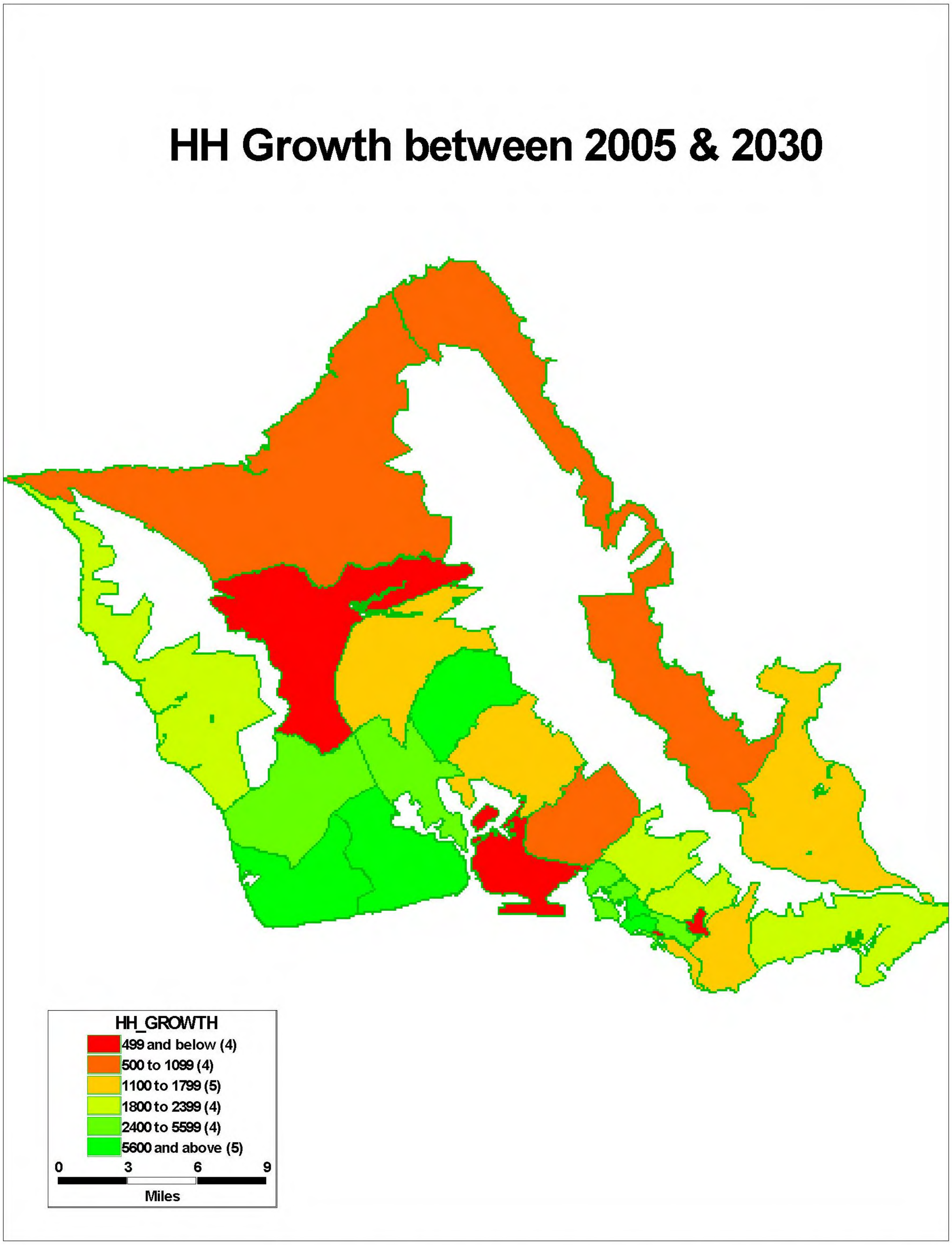


Figure 3-51: Household Growth between 2005 and 2030

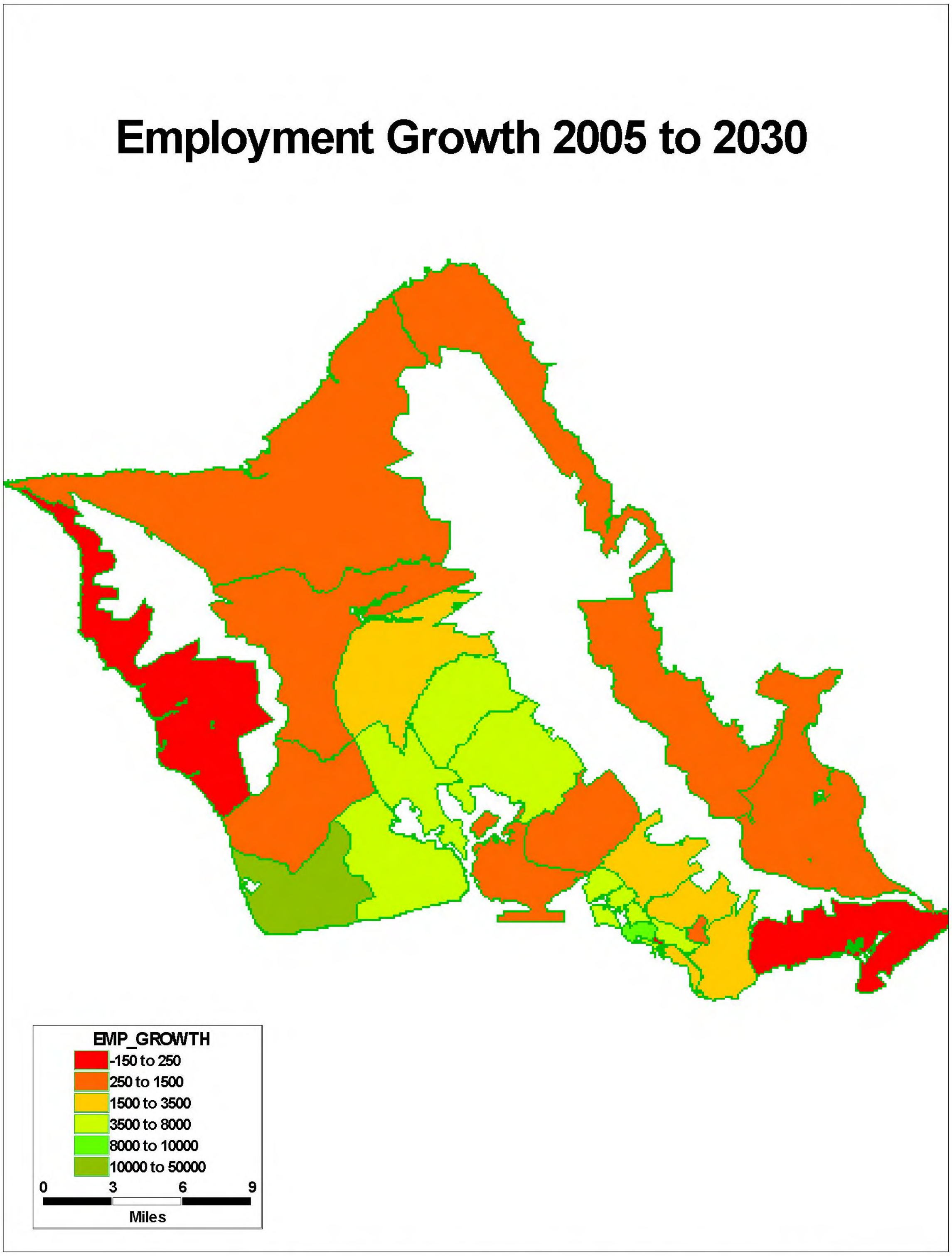


Figure 3-52: Employment Growth between 2005 and 2030

3.5.3 Fare Change

The fares used in the model reflect actual average revenue/person (i.e., out of pocket cost). The original 1995 model fare was $0.45, so to update the modeled fare, the consumer price index and increase in monthly pass cost needed to be implemented. Cash fare was calculated as original fare multiplied twice a day divided by the adjusted price of the original fare using the consumer price index of 18 percent. This resulted in $0.76 based on cash fare, or 0.45*40/29.42 = $0.61 based on passes. An average would be $0.685. The fare was updated from $0.45 to $0.68 after using the 2005 OBS data to determine the average fare for riders on the system.

3.5.4 Non-included Attributes and User Benefit Calculations

In areas where New Starts projects occur and there is no existing rail to allow for calibration of alternative specific constants and the perceived non-included attributes of rail travel, the FTA has acceptable values for calculating benefits associated with the travel savings incurred on rail. Based on their understanding of traveler behavior and past experience with areas having rail survey information, FTA has acceptable ranges for the calculation of benefits associated with rail.

Table 3-76 shows the final factors agreed upon for O‘ahu and how they compare to other systems. The equivalent in-vehicle minutes of travel time used (only) in the user benefit analysis, not in the estimation of ridership, were based upon comparisons with other systems as shown in the spreadsheet.

The maximum value that can be received is 14.5 minutes and the attribute minutes are further displayed in the table. Note that urban rail riders that do not have direct access, or transfer to/from the system, only receive 5.5 minutes. In the calculations of the benefit credits for urban rail only, a portion of the IVT can be counted towards the benefit. In Honolulu that factor was 85 percent of the IVT.

Table 3-76: Honolulu Non-included Attribute Comparison

	Max Benefit		Premium-Only Benefit								Honolulu Values	
											Build	
Non-included Attribute	Premium Only	Premium + Local	Portland	KC BRT	VRE	NY/CTA	BART	DC Metro	Street Car	Houston Busway	Premium	Local
Guideway-like characteristics	**8.0**	**3.0**	**7.0**	**2.0**	**4.0**	**7.0**	**7.5**	**7.5**	**2.0**	**6.5**	**8.0**	**3.0**
Reliability of vehicle arrival	4.0	2.0	3.5	0.0	2.0	4.0	4.0	4.0	0.0	3.0	4.0	2.0
Branding/visibility/ learnability	2.0	1.0	2.0	1.0	2.0	1.0	2.0	2.0	2.0	1.5	2.0	1.0
Schedule-free service	2.0	0.0	1.5	1.0	0.0	2.0	1.5	1.5	0.0	2.0	2.0	0.0
Span of good service	**3.0**	0.0	**3.0**	**1.0**	**0.0**	**3.0**	**3.0**	**3.0**	**2.0**	**1.5**	**3.0**	**0.0**
Passenger amenities	**4.0**	**3.0**	**2.5**	**2.0**	**3.0**	**1.5**	**4.0**	**4.0**	**1.0**	**1.0**	**3.5**	**2.5**
Stations/stops	3.0	2.0	1.5	1.0	2.0	1.5	3.0	3.0	0.0	1.0	2.5	1.5
Dynamic schedule information	1.0	1.0	1.0	1.0	1.0	0.0	1.0	1.0	1.0	0.0	1.0	1.0
TOTAL	***15.0***	***6.0***	***12.5***	***5.0***	***7.0***	***11.5***	***14.5***	***14.5***	***5.0***	***9.0***	***14.5***	***5.5***
TARGET	**15.0**	**6.0**										
IVT coefficient			0.85	0.95	0.75	0.90	0.85	0.85	0.95	0.95	0.85	
Ride quality												
Vehicle amenities												
Reliability of travel time												
Availability of seat												

Non-home-based Direct-Demand Model Calibration and Development

The NHB direct-demand model generates trip ends at each rail station based on the number of home-based alightings at each station. Factors that vary by density of station are applied to home-based alightings to estimate NHB trip ends. These factors were re-estimated as part of this project to take advantage of the new 2002 Washington Metropolitan Area Transit Authority (WMATA) on-board rail survey.

Each station density in the District of Columbia area was determined by using a one-half mile buffer around the station. The one-half mile assumption is consistent with the original approach in 1985—the assumptions used for walk access in the O‘ahuMPO travel demand model and the calculation of station densities for the O‘ahu rail line. An assumption was made that land use is homogenous across the TAZ so that a consistent GIS approach could be applied when determining station densities. A more accurate measurement of density would require the use of parcel-level data, including land use type and employment totals/type. This is recommended for future re-estimation or research.

The results of the analysis showed differences in the estimated coefficients between the 1985 and 2002 surveys, as shown in Table 3-77. The NHB trip rates estimated with the more recent data are lower for all station types and modes, with very few exceptions. To determine the extent to which differences in the number of stations between the 1985 survey and the 2002 survey are responsible for the lower trip rates (there were 26 more stations in 2002), the model was re-estimated with only the stations that were present in the 1985 survey. Given that there appears to be no significant difference between the estimation results with and without the 26 additional stations, it was concluded that the lower coefficients obtained with the 2002 data are not due to the additional stations.

Following are specific conclusions regarding the estimation data and results:

- As noted, station NHB to home-based ratios are significantly lower using the 2002 data. The significance levels of estimation results are generally consistent with previous estimation results.
- As previously estimated, less dense stations produce more NHB trip ends for each home-based alighting than more dense stations. The explanation provided with the previous study—that there are less opportunities for NHB trip attractions within walking distance of the station—is logical and appears to be supported by the new estimation results.
- There are more home-based trips in the 2002 survey compared to the original 1985 survey. This could be due to ridership increases as well as changes in the OBS instrument.
- The addition of 26 new stations in the 2002 survey provided more data points for the analysis and, therefore, changed the regression analysis totals.
- It is not intuitive why the bus or auto access trip rates are higher than the walk access trip rates in both the old estimation results and the new estimation

results. Note that although there are small numbers of home-based attractions and NHB trips that use auto as an egress mode, this is disallowed in the vast majority of trip-based travel demand models.

- Numerous stations changed density type between 1985 and 2002. The density changes on the station types (or shifts from Type 2 to 3) obviously affect the estimation results. Currently, different stratifications for station density are being investigated to maximize the between-cell variation of trip rates with respect to density.

Table 3-77: NHB Direct Generation Rate Comparison

WMATA Summary 2002

All Modes — R^2=.9645

Density Type	Coeff	t-score
1	0.331	38.18
2	0.495	23.86
3	0.666	8.4
4	1.055	6.83

Walk — R^2=.9687

Density Type	Coeff	t-score
1	0.309	42.74
2	0.411	21.95
3	0.565	6.18
4	0.750	1.72

All non-motorized travel

Bus — R^2=.9021

Density Type	Coeff	t-score
1	0.414	12.73
2	0.563	15.96
3	0.488	12.07
4	0.614	12.11

Auto — R^2=.8086

Density Type	Coeff	t-score
1	0.860	5.46
2	1.820	7.92
3	3.210	9.63
4	4.340	12.18

1985 WMATA Results

All Modes — R^2=.953

Density Type	Coeff	t-score
1	0.411	30.11
2	0.725	15.29
3	0.946	5.02
4	1.644	2.37

Walk — R^2=.958

Density Type	Coeff	t-score
1	0.400	32.87
2	0.661	14.59
3	0.842	3.80
4	0.866	0.47

All non-motorized travel

Bus — R^2=.907

Density Type	Coeff	t-score
1	0.539	11.95
2	0.837	18.05
3	0.799	8.73
4	0.782	3.90

Auto — R^2=.810

Density Type	Coeff	t-score
1	1.185	4.75
2	2.417	10.11
3	2.204	6.48
4	4.094	9.02

Re-estimate using Only Original Stations

All Modes — R^2=.9688

Density Type	Coeff	t-score
1	0.331	33.91
2	0.495	20.98
3	0.640	6.78
4	1.280	3.50

Walk — R^2=.969

Density Type	Coeff	t-score
1	0.309	35.72
2	0.410	18.12
3	0.568	4.97
4	1.610	1.57

All non-motorized travel

Bus — R^2=.904

Density Type	Coeff	t-score
1	0.414	12.19
2	0.570	15.10
3	0.470	10.40
4	0.733	6.76

Auto — R^2=.807

Density Type	Coeff	t-score
1	0.860	6.04
2	1.880	8.69
3	2.800	8.60
4	3.400	6.02

Model Application in Honolulu

The revised coefficients were applied to the MOSL alternative to calculate NHB trips and user benefits. The coefficients for all modes were used as opposed to separate walk versus bus rates, since a logical explanation for why the bus rates would be higher for station types 1 and 2 and lower for stations 3 and 4 was not obvious. In any event, the rates are similar enough that the difference is not expected to affect the final results in any meaningful way. Station densities for MOSL stations were computed using a GIS technique consistent with the calculation performed for the WMATA stations.

The resulting densities, classifications, home-based alightings, and NHB trip ends by station are given in Table 3-78. A number of different model tests were performed. Test 1 utilizes the global parameters (shown as "All Modes" in Table 3-77), which do not differentiate home-based alightings by egress mode. This test indicates a higher-than-expected number of NHB rail trip ends at stations with a relatively high number of home-based trips alighting by bus (using bus to get to their final attraction zone), such as Kahuapa'ani and AMC.

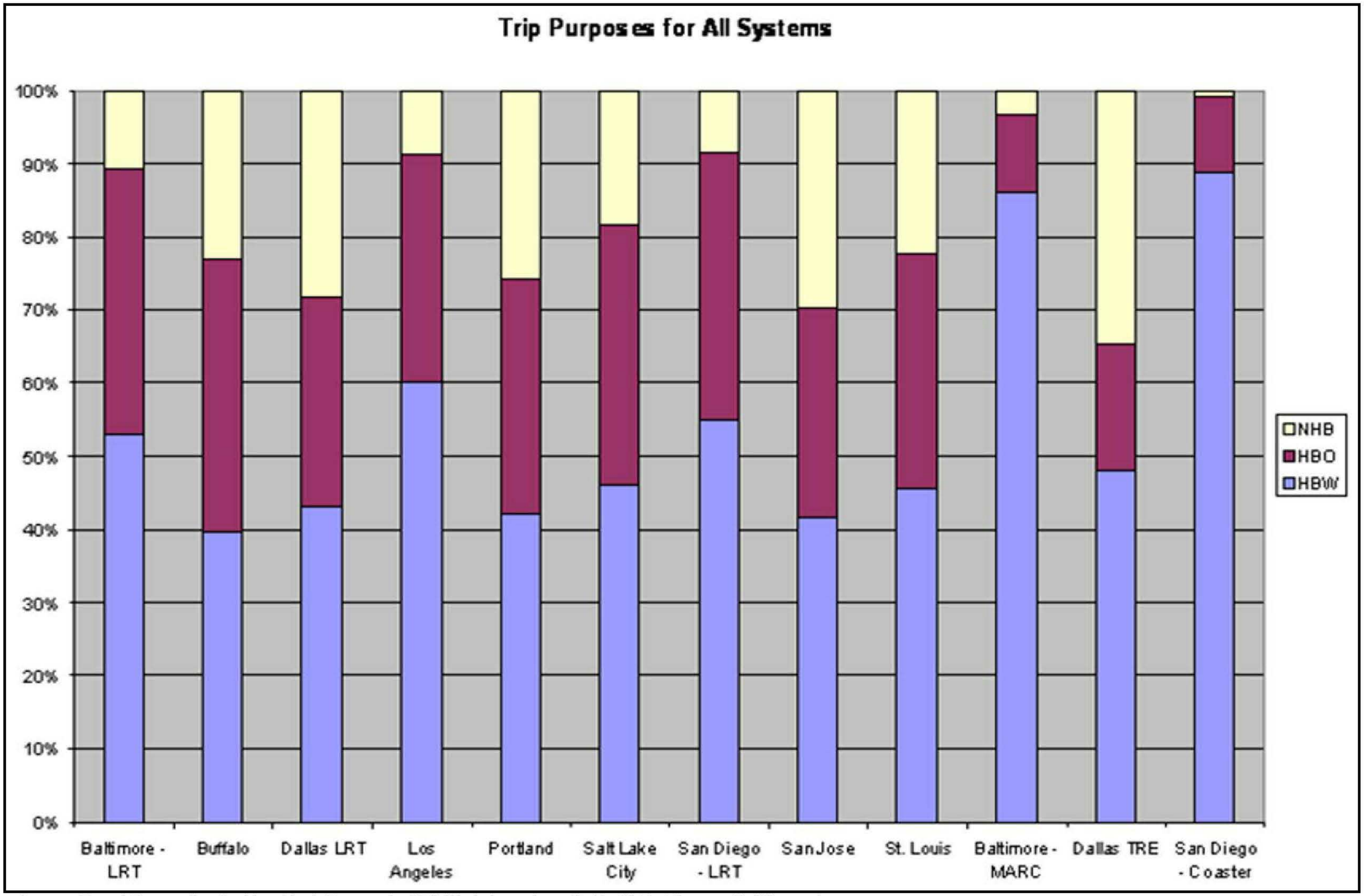
Test 2 is a run of the model that uses the different parameters for walk egress versus bus egress alightings shown in Table 3-77. This model forecasts more NHB trip ends per home-based alighting at high-density stations and less NHB trip ends per home-based bus alighting at lower-density stations. Thus, though the model predicts less NHB trip ends at Kahuapa'ani, it predicts more trip ends at AMC and was consequently rejected.

Test 3 constrains the home-based bus egress parameters to one-half of the walk parameter for each density type. This model ensures a reasonable relationship between the number of NHB trips generated by home-based walk egress trips versus bus egress trips. As a consequence, the total NHB trips generated at each station appear to be more reasonable. The total number of NHB trip ends predicted by the model is 30,359, which translates to 15,180 trips. The table indicates that there are 70,767 home-based alightings (trips) predicted by the model, so 18 percent of total rail trips would be NHB. This compares reasonably well with an analysis of rail OBS data conducted by FTA and presented at the June 2006 workshop on New Starts forecasting held in Minneapolis (shown in Figure 3-53).

A final test was conducted in which only walk egress home-based trips were used to predict NHB trip ends. This test predicts approximately 10,000 NHB trips, or only 12 percent of total trips predicted by the entire model system. This percentage is low compared to the OBSs summarized in Figure 3-53. However, in order to minimize the risk associated with the forecasts, this very conservative number of NHB trips and associated user benefits was included in the final cost effectiveness information.

Table 3-78: First Project Salt Lake Alternative Density, Station Type, Home-based Alightings, and Estimated Non-home-based Trip Ends by Station

Station	Density	Density Type	Home-Based Alightings			Test 1: Global Parameters	Test 2: Trips by Egress Mode	Test 3: Constrained Bus Parameters	Test 4: Walk Egress Only
			Total	Walk-Egress	Bus Egress				
East Kapolei	2477	4	467	167	300	493	309	334	176
UH West Oahu	2319	4	1,686	761	925	1,520	1,139	1,291	803
Ho'opili	1950	4	333	304	29	351	246	336	321
West Loch	5442	3	1,124	418	706	749	581	513	278
Waipahu Transit Center	3391	3	795	314	481	529	412	369	209
Leeward Community College	687	4	3,352	3,352	0	3,536	2,514	3,536	3,536
Pearl Highlands	6767	3	1,601	650	951	1,066	831	750	433
Pearlridge	13089	2	3,415	1,103	2,312	1,690	1,755	1,118	546
Aloha Stadium (Salt Lake)	4643	3	7,707	2,249	5,458	5,133	3,934	3,315	1,498
Ala Liliko'i	1668	4	2,494	1,681	813	2,631	1,760	2,202	1,773
Middle Street Transit Center	11745	2	3,725	1,087	2,638	1,466	1,932	1,191	538
Kalihi	16961	2	2,363	2,336	27	1,170	975	1,163	1,156
Kapālama	20872	2	2,562	2,562	0	1,268	1,053	1,268	1,268
Iwilei	17792	2	1,007	801	206	498	445	447	396
Chinatown	31041	2	1,504	1,504	0	744	618	744	744
Downtown	175528	1	5,867	5,205	662	1,942	1,882	1,832	1,723
Civic Center	50259	2	3,206	2,911	295	1,587	1,363	1,514	1,441
Kaka'ako	40552	2	2,589	2,589	0	1,282	1,064	1,282	1,282
AMC	50041	2	24,970	3,924	21,046	12,360	13,462	7,151	1,942
Total			***70,767***	***33,918***	***36,849***	***40,017***	***36,275***	***30,359***	***20,065***
Total User Benefits						-480,978	-427,446	-385,650	-299,662



Source: Travel Forecasting for New Starts Proposals, FTA Workshop, June 15-16, 2006, Minneapolis Minnesota

Figure 3-53: Percent of Rail Trips by Purpose

Non-home-based Trip Distribution

A destination-choice trip distribution model was developed for NHB trips to create an NHB rail station-station matrix. This matrix was then used to compute user benefits for NHB trips. Destination choice models are very similar to mode choice models in that both are based on a type of discrete choice model called the *logit* model. As applied to destination choice models, the logit formulation is:

$$P_i(k) = \frac{\exp(U_{k|i})}{\sum_{j \in D} \exp(U_{j|i})}$$

where:

$P_i(k)$ is the probability of selecting attraction k , given production zone i

$j \in D$ are the unique alternatives (attractions) in the sample set

U_j is the utility of selecting an attraction zone, given production zone i

The equation states that given production zone *i*, the probability of selecting an attraction zone *k* is a function of the exponential utility of selecting *k* over the sum of exponential utilities of all attractions zones in the choice set. The larger the utility of travel between production zone *i* and attraction zone *j*, the greater the probability of travel between the zones.

The utility for selecting a particular alternative is a linear function of the attributes that describe the alternative. In a destination choice model, the attributes that describe the selection of a zone include its accessibility, other variables that describe the quality of the choice (in this case distance and distance raised to some power), and variables that describe the quantity of activity in the attraction zone:

$$U_{j|i} = \beta_1 \times accessibility_{j|i} + \beta_2 \times dist_{j|i} + \beta_3 \times dist_{j|i}{}^{\beta_4} + \ln(quantity_{j|i})$$

Utility functions for destination choice look different than the comparable functions for mode choice models due to the logarithmic term. This term is referred to as the *size* term. The size term reflects the quantity of attractions in the destination zone (similar to a trip attraction model), and the logarithmic form of the term causes the probability of selecting the destination zone to be linear with respect to the number of attractions, all else being equal.

Destination choice models that use mode choice logsums as a measure of impedance have a special interpretation. The destination and mode models can be interpreted as sequentially estimated nested models. Mode choice becomes a nested choice under the choice of destination. The coefficient estimated on the mode choice logsum is interpreted as a nesting coefficient. Thus, the coefficient must range between 0 and 1. A value of 1 implies that there is no nesting. A value greater than 1 implies that the nesting order is incorrect.

The NHB direct-demand model distributes NHB trips from each production *station* to each attraction *station* using the destination choice formula described above. The quantity used in the NHB direct-demand model is the number of NHB trip ends documented in Table 3-78 above.

For the NHB direct-demand models, the walk-rail mode choice utility function was used as the measure of accessibility, as the model is distributing only NHB rail trips. The parameter values used in the NHB walk-rail utility are shown in Table 3-79. Note that there is no alternative-specific constant bonus for rail. Since the travel time and cost skims are zone-based, it was necessary to look up the closest zone to each station in order to index into the skims and find the appropriate skim value for each station-pair. A mode choice accessibility parameter of 0.75 was asserted.

Table 3-79: Non-home-based Mode Choice Model Parameter for Rail

Description	Coefficient	Equivalent Minutes of IVT/VOT
In-vehicle time coefficient	-0.0200	1.0
Cost coefficient for medium income households (20–60k)	-0.0050	$2.40/hour
First wait coefficient—up to 5 minutes	-0.0400	2.0
First wait coefficient—in excess of 5 minutes	-0.0200	1.0
Transfer wait coefficient	-0.0500	2.5
Walk time coefficient	-0.0400	2.0

Just as a gravity model is balanced to match attractions if it is doubly constrained, a shadow pricing mechanism is used to match attractions in a destination choice model. The model is applied and the probability for each attraction station is computed for each production station. The probabilities are multiplied by the trips produced at each production station (in this case, NHB trip ends/2), and the resulting attractions are summed up by attraction station. If the station attractions predicted by the destination choice model are greater than the NHB trips generated, a shadow price is estimated as –ln (predicted/generated) and this term is added to the utility for the attraction zone. The model is iterated until the destination choice model predicts the correct number of trip attractions at each station according to the NHB direct-demand trips generated.

It is often necessary to add distance-based parameters when calibrating a destination choice model that relies on a mode choice logsum as the measure of accessibility, due to the relatively limited distribution of the accessibility variable and the constraint that the logsum parameter must be between 0 and 1. After comparing the results of the trip distribution model to the WMATA NHB trip table, it was clear that additional calibration was necessary. Therefore, distance and power-distance terms were added to the destination choice utility equation, and the parameters on these terms were fitted to match the WMATA NHB rail trip length frequency distribution by distance (highway) between stations. Figure 3-54 shows the initial run distribution compared to the WMATA data and the final calibrated model results.

The final utility equation for the NHB direct-demand destination choice model is as follows:

$$U_{j|i} = 0.75 \times railUtility_{j|i} + -0.125 \times dist_{j|i} + -0.02 \times dist_{j|i}^{1.2} + \ln(NHBTripEnds_{j|i})$$

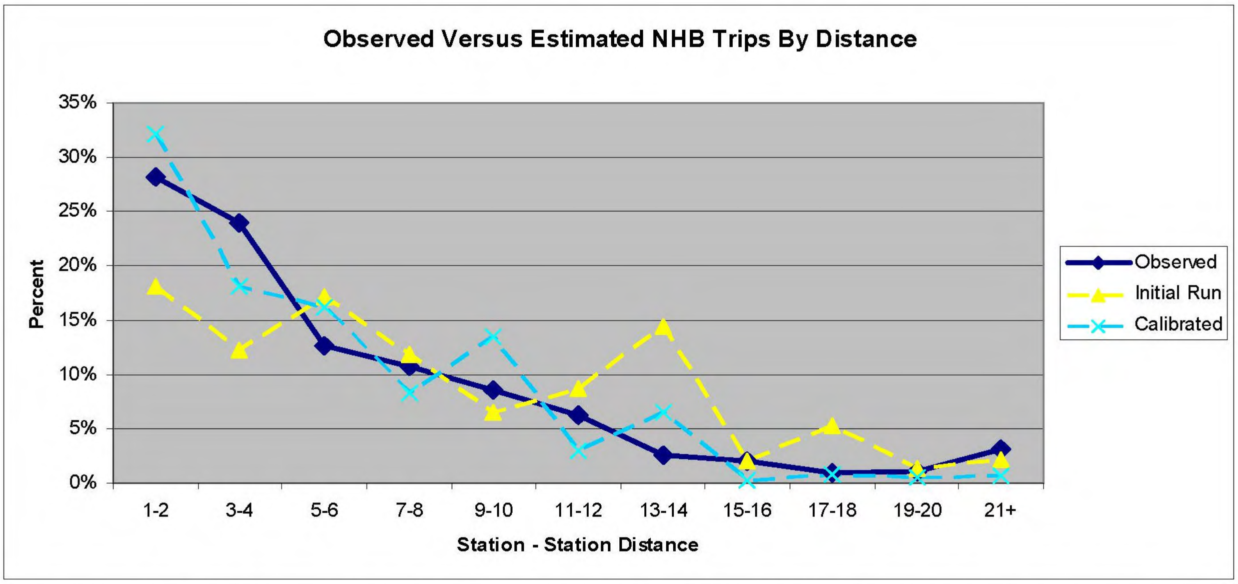


Figure 3-54: Observed (WMATA) versus Estimated (O'ahu) Non-home-based Rail Trips by Station Distance

Calculation of User Benefits

The calculation of user benefits for NHB direct-demand trips required a simplifying assumption that those trips would have been made in the baseline alternative by the next best transit mode. The user benefits are computed as the difference between the cost of travel by rail in the build versus the cost of travel by bus in the baseline, multiplied by the number of NHB direct-demand trips in the build scenario, and converted to equivalent minutes of travel time.

These calculations are performed within the Java application program as the FTA SUMMIT program is not structured to perform these calculations. In summary, the model predicts 10,033 NHB rail trips, and 4,994 hours of user benefits, for about 30 minutes of user benefit per NHB trip. Those benefits seem reasonable given the differences in transit accessibility (both IVT and headway are significantly improved) between the baseline and build alternatives. As previously noted, there is no alternative-specific constant bonus given to rail.

The following tables show the results of the direct-demand models at a station-station level. Table 3-80 shows the station-station NHB trip table matrix. Table 3-81 is the station-station user benefit matrix. Table 3-82 and Table 3-83 show the station-station transit IVT matrix for the baseline and MOSL build alternatives respectively.

Table 3-80: Station-to-station Non-home-based Trip Matrix

From Station	To Station																			Total
	East Kapolei	UH West Oahu	Hoʻopili	West Loch	Waipahu Transit Center	Leeward Community College	Pearl Highlands	Pearlridge	Aloha Stadium (Salt Lake)	Ala Lilikoʻi	Middle Street Transit Center	Kalihi	Kapālama	Iwilei	Chinatown	Downtown	Civic Center	Kakaʻako	AMC	
East Kapolei	0	41	5	2	1	28	1	1	3	2	0	1	1	0	0	1	0	0	1	***88***
UH West Oahu	32	0	30	18	8	220	8	10	23	17	4	6	5	1	2	5	4	3	5	***401***
Hoʻopili	6	44	0	6	3	71	3	3	7	6	1	2	2	0	1	2	1	1	2	***160***
West Loch	3	28	6	0	3	70	3	3	7	5	1	2	2	0	1	2	1	1	2	***139***
Waipahu Transit Center	1	14	3	3	0	58	2	3	6	5	1	2	1	0	1	1	1	1	1	***105***
Leeward Community College	32	175	84	79	63	0	156	132	311	236	51	77	73	18	31	73	56	46	76	***1,768***
Pearl Highlands	1	7	3	3	2	156	0	5	12	9	2	3	3	1	1	3	2	2	3	***216***
Pearlridge	2	9	4	4	3	133	5	0	34	26	6	9	8	2	3	8	6	5	8	***273***
Aloha Stadium (Salt Lake)	4	20	8	8	6	304	11	33	0	112	20	38	36	9	15	36	28	23	38	***749***
Ala Lilikoʻi	2	11	6	6	5	228	9	25	109	0	40	71	73	19	30	70	57	46	78	***887***
Middle Street Transit Center	1	3	1	1	1	45	2	5	19	40	0	24	25	6	10	25	19	16	26	***269***
Kalihi	1	4	2	1	1	68	3	8	38	74	23	0	66	17	30	70	53	44	74	***578***
Kapālama	1	5	2	2	2	75	3	9	36	67	24	66	0	21	35	83	64	52	89	***634***
Iwilei	0	1	0	0	0	20	1	2	8	17	6	16	21	0	11	26	20	17	28	***198***
Chinatown	0	2	1	1	1	32	1	4	15	30	10	29	35	11	0	58	44	36	61	***372***
Downtown	1	5	2	2	2	77	3	9	37	72	23	69	84	27	59	0	121	100	169	***861***
Civic Center	1	4	1	1	1	58	2	7	27	54	17	52	63	20	44	124	0	90	154	***720***
Kakaʻako	1	3	1	1	1	46	2	5	23	44	14	43	52	17	37	103	92	0	158	***641***
AMC	1	5	2	2	2	82	3	10	35	71	25	72	86	28	62	175	151	159	0	***971***
Total	***88***	***381***	***161***	***139***	***105***	***1,772***	***217***	***274***	***750***	***889***	***270***	***579***	***635***	***199***	***373***	***863***	***722***	***642***	***973***	***10,033***

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Table 3-81: Station-to-station Non-home-based User Benefit Matrix (Cost Difference)

	To Station																			
From Station	East Kapolei	UH West Oahu	Ho'opili	West Loch	Waipahu Transit Center	Leeward Community College	Pearl Highlands	Pearlridge	Aloha Stadium (Salt Lake)	Ala Liliko'i	Middle Street Transit Center	Kalihi	Kapālama	Iwilei	Chinatown	Downtown	Civic Center	Kaka'ako	AMC	***Total***	Per Trip
East Kapolei	0	267	-92	-57	-34	-1,609	-61	-57	-124	-144	-24	-20	-17	-4	-8	-23	-19	-18	-21	***-2,065***	-23
UH West Oahu	108	0	-122	-167	-128	-10,718	-405	-361	-794	-884	-148	-86	-64	-16	-35	-112	-96	-102	-92	***-14,222***	-35
Ho'opili	-48	-119	0	-24	-38	-3,404	-129	-116	-256	-392	-76	-62	-86	-13	-25	-68	-56	-53	-63	***-5,027***	-31
West Loch	-27	-126	-6	0	-24	-2,974	-112	-98	-215	-370	-69	-72	-76	-15	-20	-56	-51	-41	-74	***-4,426***	-32
Waipahu Transit Center	-20	-164	-38	-17	0	-1,849	-70	-73	-182	-425	-63	-77	-73	-19	-25	-64	-63	-45	-79	***-3,345***	-32
Leeward Community College	-1,403	-6,304	-3,107	-2,399	-1,803	0	-1,393	-5,169	-12,731	-24,236	-3,930	-4,795	-4,551	-1,189	-2,257	-5,672	-4,441	-4,036	-5,498	***-94,912***	-54
Pearl Highlands	-53	-238	-117	-91	-68	-1,391	0	-195	-481	-915	-148	-181	-172	-45	-85	-214	-168	-152	-208	***-4,921***	-23
Pearlridge	-36	-167	-77	-61	-44	-4,062	-154	0	-437	-1,550	-242	-290	-240	-61	-117	-324	-265	-240	-324	***-8,690***	-32
Aloha Stadium (Salt Lake)	-49	-192	-90	-71	-56	-7,389	-279	-152	0	-4,135	-437	-417	-282	-79	-192	-661	-578	-580	-624	***-16,263***	-22
Ala Liliko'i	-104	-438	-400	-370	-252	-15,363	-581	-1,133	-3,836	0	-341	-2,674	-2,141	-330	-812	-2,302	-2,035	-1,783	-2,602	***-37,498***	-42
Middle Street Transit Center	-21	-61	-37	-32	-41	-2,996	-113	-182	-374	-1,463	0	-633	-463	-45	-174	-553	-487	-439	-604	***-8,720***	-32
Kalihi	-12	-13	-56	-41	-38	-2,885	-109	-178	-309	-2,952	-674	0	-307	-187	-501	-1,526	-1,166	-1,358	-1,403	***-13,716***	-24
Kapālama	-22	0	-38	-32	-39	-3,041	-115	-178	-213	-1,989	-598	-185	0	-80	-332	-1,198	-1,226	-1,371	-1,304	***-11,961***	-19
Iwilei	-3	1	-12	-10	-11	-797	-30	-30	-75	-241	-163	-323	-299	0	-67	-309	-310	-398	-528	***-3,602***	-18
Chinatown	-7	-15	-24	-21	-26	-1,719	-65	-96	-251	-656	-317	-502	-426	-57	0	-517	-574	-568	-534	***-6,374***	-17
Downtown	-21	-59	-66	-29	-49	-4,762	-180	-284	-763	-1,980	-891	-1,531	-1,688	-289	-812	0	-1,179	-1,211	-2,236	***-18,029***	-21
Civic Center	-17	-49	-31	-21	-36	-3,261	-123	-234	-611	-1,976	-726	-1,085	-990	-402	-858	-1,232	0	-923	-1,952	***-14,526***	-20
Kaka'ako	-14	-43	-29	-21	-33	-2,747	-104	-167	-585	-1,477	-505	-1,052	-1,008	-355	-589	-1,276	-1,146	0	-1,270	***-12,420***	-19
AMC	-15	-21	-52	-44	-62	-4,674	-177	-248	-389	-1,958	-769	-1,282	-1,193	-296	-1,269	-2,904	-2,339	-1,253	0	***-18,942***	-20
Total	***-1,763***	***-7,740***	***-4,396***	***-3,507***	***-2,781***	***-75,641***	***-4,199***	***-8,952***	***-22,625***	***-47,744***	***-10,121***	***-15,268***	***-14,076***	***-3,482***	***-8,178***	***-19,012***	***-16,197***	***-14,569***	***-19,413***	**-299,662**	**-30**
Per Trip	-20	-20	-27	-25	-27	-43	-19	-33	-30	-54	-38	-26	-22	-18	-22	-22	-22	-23	-20	-30	

Table 3-82: Station-to-station Baseline Transit In-vehicle Time Matrix

From Station	To Station																			*Weighted Average*
	East Kapolei	UH West Oahu	Ho'opili	West Loch	Waipahu Transit Center	Leeward Community College	Pearl Highlands	Pearlridge	Aloha Stadium (Salt Lake)	Ala Liliko'i	Middle Street Transit Center	Kalihi	Kapālama	Iwilei	Chinatown	Downtown	Civic Center	Kaka'ako	AMC	
East Kapolei	0	3	17	24	24	34	34	50	62	61	38	40	44	46	50	52	54	61	61	***21***
UH West Oahu	3	0	9	16	22	31	31	47	59	56	33	36	39	42	46	48	49	57	56	***26***
Ho'opili	11	5	0	7	15	24	24	38	51	60	62	39	70	45	49	51	53	64	60	***26***
West Loch	15	9	4	0	7	17	17	31	43	48	55	43	62	32	35	37	39	57	60	***20***
Waipahu Transit Center	19	14	8	4	0	10	10	25	41	60	51	62	68	71	44	44	48	50	53	***23***
Leeward Community College	24	19	14	10	5	0	0	16	31	50	40	53	58	61	66	68	74	79	65	***24***
Pearl Highlands	24	19	14	10	5	0	0	16	31	50	40	53	58	61	66	68	74	79	65	***28***
Pearlridge	30	24	19	18	13	8	8	0	14	44	24	35	32	34	38	40	41	45	48	***27***
Aloha Stadium (Salt Lake)	35	29	24	20	20	15	15	7	0	24	12	22	19	21	25	27	29	33	36	***23***
Ala Liliko'i	51	45	61	57	37	31	31	30	23	0	9	26	23	20	25	27	31	36	40	***32***
Middle Street Transit Center	49	37	38	34	31	51	51	27	14	21	0	8	15	12	17	19	23	27	32	***26***
Kalihi	26	20	47	43	38	33	33	25	19	23	4	0	5	9	13	16	22	27	22	***24***
Kapālama	50	23	39	35	42	36	36	20	15	18	7	3	0	4	8	10	10	21	17	***19***
Iwilei	31	25	41	37	32	27	27	19	17	14	13	7	4	0	5	7	11	15	20	***15***
Chinatown	32	26	42	38	47	41	41	22	18	17	13	8	5	3	0	2	8	11	10	***13***
Downtown	34	28	44	31	26	43	43	23	19	20	15	15	8	6	2	0	3	9	9	***11***
Civic Center	38	32	37	33	28	51	51	29	36	25	20	18	15	7	4	2	0	5	11	***9***
Kaka'ako	40	34	41	37	32	50	50	32	36	28	25	17	14	11	10	9	6	0	7	***22***
AMC	47	41	52	49	45	59	59	33	28	32	29	20	14	16	14	14	12	7	0	***11***
Weighted Average	***16***	***13***	***20***	***17***	***17***	***18***	***21***	***25***	***29***	***32***	***22***	***20***	***17***	***14***	***14***	***13***	***11***	***29***	***12***	***23***

Table 3-83: Station-to-station Build Transit In-vehicle Time Matrix

	To Station																			
From Station	East Kapolei	UH West Oahu	Ho'opili	West Loch	Waipahu Transit Center	Leeward Community College	Pearl Highlands	Pearlridge	Aloha Stadium (Salt Lake)	Ala Liliko'i	Middle Street Transit Center	Kalihi	Kapālama	Iwilei	Chinatown	Downtown	Civic Center	Kaka'ako	AMC	*Weighted Average*
East Kapolei	0	2	5	7	9	12	12	16	19	23	26	28	30	31	33	34	36	37	39	***8***
UH West Oahu	2	0	3	6	8	10	10	15	18	21	25	27	28	30	32	33	34	36	38	***11***
Ho'opili	5	3	0	2	5	7	7	11	14	18	21	23	25	26	28	29	31	32	34	***10***
West Loch	7	6	2	0	2	5	5	9	12	16	19	21	23	24	26	27	29	30	32	***8***
Waipahu Transit Center	9	8	5	2	0	2	2	7	10	13	17	19	20	22	24	25	26	28	30	***8***
Leeward Community College	12	10	7	5	2	0	0	5	7	11	15	16	18	19	21	23	24	25	28	***7***
Pearl Highlands	12	10	7	5	2	0	0	5	7	11	15	16	18	19	21	23	24	25	28	***9***
Pearlridge	16	15	11	9	7	5	5	0	3	6	10	12	13	15	17	18	20	21	23	***10***
Aloha Stadium (Salt Lake)	19	18	14	12	10	7	7	3	0	3	7	9	10	12	14	15	17	18	20	***10***
Ala Liliko'i	23	21	18	16	13	11	11	6	3	0	4	6	7	9	11	12	13	15	17	***12***
Middle Street Transit Center	26	25	21	19	17	15	15	10	7	4	0	2	3	5	7	8	10	11	13	***9***
Kalihi	28	27	23	21	19	16	16	12	9	6	2	0	1	3	5	6	8	9	11	***9***
Kapālama	30	28	25	23	20	18	18	13	10	7	3	1	0	2	4	5	6	8	10	***8***
Iwilei	31	30	26	24	22	19	19	15	12	9	5	3	2	0	2	3	5	6	8	***7***
Chinatown	33	32	28	26	24	21	21	17	14	11	7	5	4	2	0	1	3	4	6	***6***
Downtown	34	33	29	27	25	23	23	18	15	12	8	6	5	3	1	0	1	3	5	***5***
Civic Center	36	34	31	29	26	24	24	20	17	13	10	8	6	5	3	1	0	1	3	***4***
Kaka'ako	37	36	32	30	28	25	25	21	18	15	11	9	8	6	4	3	1	0	2	***12***
AMC	39	38	35	32	30	28	28	23	20	17	13	11	10	8	6	5	4	2	0	***5***
Weighted Average	***9***	***9***	***10***	***8***	***9***	***8***	***9***	***10***	***10***	***12***	***9***	***9***	***8***	***7***	***6***	***5***	***4***	***12***	***5***	***10***

3.6 Calibration and Validation

The O‘ahu travel demand model was re-calibrated to a 2005 base year as a result of the changes discussed in this report. This section outlines the calibration efforts not discussed in previous sections of the document.

3.6.1 Calibration Target Values

Ideally, the HIS and the OBS should be performed in the same year. However, the HIS for O‘ahu was from 1995 and an OBS was done in 2005 to develop updated transit characteristics. The control totals for 2005 were calculated using the model run performed on September 5, 2006, and the 1995 HIS established the relative proportions between auto and auxiliary. The transit shares were determined by the number of transit trips from the 2005 OBS. Table 3-84 shows the shares used in the calibrated model for the Honolulu AA project in the spring of 2007. Table 3-85 shows the shares used to calibrate to the year 2005. Since it was not possible to obtain the same trip purposes from the 2005 OBS as the 1995 HIS, the HIS proportions of transit trips for the journey-to-work—work-based and journey-to-work—non-based, journey-at-work—work-based and journey-at-work—non-based, and non-work-related—non-home-based purposes were used to proportion out the non-home-based trip purposes from the OBS. Also the HIS transit trip proportions for journey-to-work—home-based-other, non-work-related—home-based-shopping, and non-work-related—home-based-other purposes were used to proportion out the home-based-shopping and home-based-other trip purposes from the OBS. Also, the OBS shows that of the trips that were designated as PNR, a large proportion of those trips were at informal locations. Another variable was added at the bottom of Table 3-85 that shows the proportion of PNR trips that were at informal locations.

Upon reviewing Table 3-84, there is a relatively high proportion of drive access trips for the non-home-based trip purposes (mainly journey-to-work—work-based, journey-at-work—work-based, and non-work-related—non-home-based). After looking at the OBS, it was determined that some of these trips must have been part of a tour and that the surveyed person referred back to the original access mode, rather than indicating the access mode for this trip—which was probably walk. Instead of making the drive access share 0 percent for all non-home-based trips, the split between drive access and walk access will be 1 percent, 99 percent, respectively, for all non-home-based purposes.

The shares are calculated from the 1995 HIS, and (for transit alternatives) from the 1991 transit ridership survey. Table 3-84 shows the shares that currently exist in O‘ahuMPO’s Guide to Model Form Table 5.2-8. Table 3-85 shows the shares that will be used as a result of eliminating the geographical constant on Level 1 of the mode choice model. This table also eliminates the auto-ownership breakdown for drive path modes on Level 3 of the mode choice model. The auto-ownership market was removed from Level 3 for drive path modes since the shares by auto-ownership are identical for every trip purpose except home-based-work, which was only different by about 3 percent (Table 3-84).

Key to Tables in Sections 3.6, 3.7, and 3.8:

S0, S1, S2	=	Shares for households with 0 cars, 1 car, and 2 cars, respectively
K0, K1, K2	=	Constants for households with 0 cars, 1 car, and 2 cars, respectively
CBD	=	Attraction end of trip is in Central Business District
OTH	=	Attraction end of trip is in Core Commercial and Core Residential area
ELS	=	Attraction end of trip is in urban, suburban, or rural area
HWY	=	Mode is auto in level 1 of the mode choice model
TRN	=	Mode is transit in level 1 of the mode choice model
AUX	=	Mode is non-motorized in level 1 of the mode choice model
O1	=	Mode is drive alone in level 2 of the mode choice model
SR	=	Mode is shared ride in level 2 of the mode choice model
OCC2	=	Mode is shared ride 2-persons in level 3 of the mode choice model
OCC3	=	Mode is shared ride 3 or more persons in level 3 of the mode choice model
WACC	=	Mode is walk access to transit in level 2 of the mode choice model
DACC	=	Mode is drive access to transit in level 2 of the mode choice model
NGDWY	=	Mode is walk access to local bus in level 3 of the mode choice model
GDWY	=	Mode is walk access to guideway in level 3 of the mode choice model
PREM	=	Mode is walk access to premium bus in level 3 of the mode choice model
PNR	=	Mode is park-and-ride in level 3 of the mode choice model
KNR	=	Mode is kiss-and-ride in level 3 of the mode choice model
AUXW	=	Mode is walk in level 2 of the mode choice model
AUXB	=	Mode is bike in level 2 of the mode choice model
JAW	=	journey-at-work
JAW-AN	=	journey-at-work—non-home-based (was NB)
JAW-AW	=	journey-at-work—work-based (was WB)
JTW	=	journey-to-work
JTW-WH	=	journey-to-work—home-based-work (was HBW)
JTW-WN	=	journey-to-work—non-home-based (was NB)
JTW-WO	=	journey-to-work—home-based-other (was HBNW)
JTW-WW	=	journey-to-work—work-based (was WB)
NC	=	non-work-related—home-based-college (was HBCol)
NK	=	non-work-related—home-based-school (K-12) (was HBK12)
NN	=	non-work-related—non-home-based (was NHB)
NO	=	non-work-related—home-based-other (was HBOth)
NS	=	non-work-related—home-based-shopping (was HBShp)

Table 3-84: Observed Shares for 2005 Calibration Year for May 2007 Submittal to FTA

Purpose >	Journey to/from Work (JTW)				Journey-at-work (JAW)		Non-work-related				
Share \/	HBW	HBNW	WB	NB	WB	NB	HBK12	HBCol	HBShp	HBOth	NHB
Level 1—Mode											
S0cbdHwy	0.13	0.07	—	—	—	—	0.98	0.01	0.01	0.06	—
S0cbdTrn	0.56	0.62	—	—	—	—	0.01	0.45	0.62	0.45	—
S0cbdAux	0.31	0.31	—	—	—	—	0.01	0.54	0.37	0.49	—
S0othHwy	0.05	0.16	—	—	—	—	0.01	0.10	0.11	0.21	—
S0othTrn	0.68	0.24	—	—	—	—	0.37	0.10	0.34	0.29	—
S0othAux	0.27	0.60	—	—	—	—	0.62	0.80	0.55	0.50	—
S0elsHwy	0.21	0.24	—	—	—	—	0.08	0.01	0.55	0.20	—
S0elsTrn	0.66	0.16	—	—	—	—	0.06	0.29	0.08	0.28	—
S0elsAux	0.13	0.61	—	—	—	—	0.86	0.70	0.37	0.52	—
S1cbdHwy	0.49	0.73	0.72	0.78	0.27	0.15	0.24	0.22	0.72	0.67	0.59
S1cbdTrn	0.40	0.15	0.10	0.08	0.03	0.01	0.01	0.77	0.09	0.07	0.16
S1cbdAux	0.11	0.11	0.18	0.15	0.71	0.84	0.75	0.01	0.18	0.25	0.26
S1othHwy	0.68	0.90	0.85	0.87	0.70	0.91	0.38	0.98	0.93	0.87	0.81
S1othTrn	0.16	0.04	0.05	0.05	0.02	0.01	0.18	0.01	0.01	0.05	0.05
S1othAux	0.16	0.06	0.10	0.09	0.27	0.08	0.44	0.01	0.06	0.07	0.14
S1elsHwy	0.80	0.96	0.95	0.97	0.89	0.95	0.42	0.65	0.86	0.84	0.90
S1elsTrn	0.08	0.01	0.01	0.01	0.01	0.01	0.13	0.22	0.04	0.03	0.02
S1elsAux	0.12	0.03	0.04	0.02	0.11	0.04	0.45	0.13	0.10	0.13	0.08
S2cbdHwy	0.77	0.97	—	—	—	—	0.90	0.68	0.91	0.90	—
S2cbdTrn	0.22	0.03	—	—	—	—	0.09	0.31	0.08	0.03	—
S2cbdAux	0.02	0.01	—	—	—	—	0.01	0.01	0.01	0.07	—
S2othHwy	0.88	0.97	—	—	—	—	0.93	0.48	0.88	0.89	—
S2othTrn	0.09	0.02	—	—	—	—	0.04	0.52	0.05	0.04	—
S2othAux	0.03	0.01	—	—	—	—	0.03	0.01	0.07	0.07	—
S2elsHwy	0.92	0.98	—	—	—	—	0.74	0.86	0.98	0.92	—
S2elsTrn	0.05	0.00	—	—	—	—	0.07	0.04	0.00	0.01	—
S2elsAux	0.04	0.02	—	—	—	—	0.19	0.11	0.01	0.07	—
Level 2—Highway Shared Ride											
S1o1	0.66	0.39	0.74	0.37	0.74	0.58	0.01	0.64	0.31	0.33	0.25
S1sr	0.34	0.61	0.26	0.64	0.26	0.42	0.99	0.36	0.70	0.67	0.75
S2o1	0.81	0.42	—	—	—	—	0.06	0.82	0.38	0.34	—
S2sr	0.19	0.58	—	—	—	—	0.94	0.19	0.62	0.67	—

Table 3-84: Observed Shares for 2005 Calibration Year for May 2007 Submittal to FTA (continued)

Purpose >	Journey to/from Work (JTW)				Journey-at-work (JAW)		Non-work-related				
Share \/	HBW	HBNW	WB	NB	WB	NB	HBK12	HBCol	HBShp	HBOth	NHB
Level 3—Highway Shared Ride Occupancy											
Socc2	0.81	0.62	0.79	0.68	0.72	0.80	0.38	0.77	0.58	0.55	0.52
Socc3	0.19	0.38	0.21	0.32	0.28	0.20	0.62	0.23	0.43	0.45	0.48
Level 2—Transit Access											
S0wacc	0.99	0.99	—	—	—	—	0.93	0.99	0.99	0.99	—
S0dacc	0.01	0.01	—	—	—	—	0.07	0.01	0.01	0.01	—
S1wacc	0.96	0.95	0.82	0.99	0.92	0.99	1.00	0.99	0.98	0.98	0.97
S1dacc	0.05	0.05	0.18	0.01	0.08	0.01	0.00	0.01	0.02	0.02	0.03
S2wacc	0.85	0.99	—	—	—	—	0.85	0.96	0.91	0.97	—
S2dacc	0.15	0.01	—	—	—	—	0.16	0.04	0.10	0.03	—
Level 3—Transit Walk Path											
Sngdwy	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Sgdwy	—	—	—	—	—	—	—	—	—	—	—
Sprem	—	—	—	—	—	—	—	—	—	—	—
Level 3—Transit Drive Path											
S1Pnr	0.38	0.30	0.19	0.19	0.19	0.19	0.30	0.30	0.30	0.30	0.19
S1Knr	0.62	0.70	0.81	0.81	0.81	0.81	0.70	0.70	0.70	0.70	0.81
S2Pnr	0.35	0.30	—	—	—	—	0.30	0.30	0.30	0.30	—
S2Knr	0.65	0.70	—	—	—	—	0.70	0.70	0.70	0.70	—
Level 2—Auxiliary Path											
Sauxw	0.79	0.92	0.94	0.99	0.96	0.99	0.93	0.63	0.92	0.91	0.95
Sauxb	0.21	0.08	0.06	0.01	0.04	0.01	0.07	0.37	0.08	0.09	0.05

Purposes not based at home are not stratified by vehicle ownership—S1 shares apply across all vehicle-ownership strata.
"—"indicates cell not applicable.

Table 3-85: Observed Shares for 2005 Calibration Year for Draft EIS Project

Purpose >	Journey to/from Work (JTW)				Journey-at-work (JAW)		Non-work-related				
Share \/	HBW	HBNW	WB	NB	WB	NB	HBK12	HBCol	HPShp	HBOth	NHB
Auto-Ownership/Level 1 Mode											
S0Hwy	0.151	0.262					0.121	0.010	0.218	0.161	
S0Trn	0.612	0.288					0.229	0.850	0.301	0.335	
S0Aux	0.236	0.450					0.650	0.140	0.481	0.503	
S1Hwy	0.723	0.932	0.877	0.890	0.716	0.484	0.552	0.703	0.864	0.836	0.886
S1Trn	0.152	0.025	0.052	0.071	0.026	0.403	0.075	0.175	0.037	0.034	0.010
S1Aux	0.124	0.043	0.071	0.038	0.258	0.113	0.372	0.123	0.099	0.130	0.105
S2Hwy	0.898	0.975					0.764	0.748	0.969	0.912	
S2Trn	0.069	0.009					0.058	0.162	0.011	0.016	
S2Aux	0.033	0.017					0.178	0.089	0.019	0.072	
Level 2—Highway Shared Ride											
S1o1	0.659	0.387	0.745	0.367	0.736	0.579	0.007	0.638	0.305	0.327	0.250
S1sr	0.341	0.613	0.255	0.633	0.264	0.421	0.993	0.362	0.695	0.673	0.750
S2o1	0.806	0.420	—	—	—	—	0.061	0.815	0.382	0.335	—
S2sr	0.194	0.580	—	—	—	—	0.939	0.185	0.618	0.665	—
Level 3—Highway Shared Ride Occupancy											
Socc2	0.81	0.62	0.79	0.68	0.72	0.8	0.38	0.77	0.58	0.55	0.52
Socc3	0.19	0.38	0.21	0.32	0.28	0.2	0.62	0.23	0.43	0.45	0.48
Level 2—Transit Access											
S0wacc	0.977	0.964	—	—	—	—	0.971	0.991	0.964	0.964	—
S0dacc	0.023	0.036	—	—	—	—	0.029	0.009	0.036	0.036	—
S1wacc	0.913	0.882	0.99	0.99	0.99	0.99	0.935	0.916	0.946	0.960	0.99
S1dacc	0.087	0.118	0.01	0.01	0.01	0.01	0.065	0.084	0.054	0.040	0.01
S2wacc	0.781	0.995	—	—	—	—	0.907	0.899	0.729	0.906	—
S2dacc	0.219	0.005	—	—	—	—	0.093	0.101	0.271	0.094	—
Level 3—Transit WALK/DRIVE Path											
Sngdwy	0.897	0.903	0.969	0.928	1.000	1.000	0.973	0.959	1.000	1.000	1.000
Sprem	0.103	0.097	0.031	0.072	0.000	0.000	0.027	0.041	0.000	0.000	0.000
Sgdwy	0	0	0	0	0	0	0	0	0	0	0
Level 3 Mode—Drive Access											
PNR	0.242	0.15	0.01	0.01	0.01	0.01	0.205	0.292	0.01	0.01	0.01
KNR	0.758	0.85	0.99	0.99	0.99	0.99	0.795	0.708	0.99	0.99	0.99

Table 3-85: Observed Shares for 2005 Calibration Year for Draft EIS Project (continued)

Purpose >	Journey to/from Work (JTW)				Journey-at-work (JAW)		Non-work-related				
Share \/	HBW	HBNW	WB	NB	WB	NB	HBK12	HBCol	HPShp	HBOth	NHB
Level 3 Mode—Transit DRIVE Path by Auto-Ownership											
S1Pnr	0.367	0.2	0.01	0.01	0.01	0.01	0.137	0.000	0.01	0.01	0.01
S1Knr	0.633	0.8	0.99	0.99	0.99	0.99	0.863	1.000	0.99	0.99	0.99
S2Pnr	0.207	0.1	—	—	—	—	0.247	0.329	0.01	0.01	—
S2Knr	0.793	0.9	—	—	—	—	0.753	0.671	0.99	0.99	—
Level 2—Auxiliary Path											
Sauxw	0.791	0.850	0.936	0.990	0.962	0.99	0.900	0.540	0.922	0.909	0.952
Sauxb	0.209	0.150	0.064	0.010	0.038	0.01	0.100	0.460	0.078	0.091	0.048
Informal Park-and-ride											
Sinfl	0.9	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99

Purposes not based at home are not stratified by vehicle ownership—S1 shares apply across all vehicle-ownership strata.
"—"indicates cell not applicable.

3.7 Model Calibration

All of the changes discussed in the document were used to re-calibrate the model. Stratifying the initial wait time and transit skims based on the new conical delay functions and the updated calibration target values were used.

Table 3-86 shows the original calibrated constants from the AA phase, and Table 3-87 shows the new constants, after calibration. Table 3-86 shows there were some extremely large positive and negative constants in the model, which worked to overwhelm any level of service differences. The journey-to-work—home-based-work, home-based-school, and, to some degree, home-based-college and home-based-shopping purposes, the 2+ auto drive-access constant is very large while the 2+ auto KNR constant is equally negative. The source of these large constants is a lack of market share for PNR trips. This forces the KNR constant to become very small, as the PNR mode seeks to capture 100 percent of the available trips. The drive-access constant becomes large in an effort to capture more overall drive access trips for PNR. In the new model re-calibration, the KPKNR constant is used to allow some KNR markets to be used for PNR. With a larger market, this allows much more moderate constants for both drive access and KNR. The skimming changes for the informal PNR/KNR modes also assisted in improving these constants.

Another instance of extreme constants in the previous model calibration occurs for constants related to non-motorized modes. This occurs for journey-to-work—home-based-other, journey-at-work—non-based, home-based-school, home-based-college, and home-based-other. These very high positive constants are most likely a result of insufficient non-motorized markets. The new model addresses this by allowing intra-zonal non-motorized times and by allowing a relaxation of the 30-minute maximum non-motorized time. The presence of the intra-zonal times is the most important change. The new calibrated non-motorized constants are, in some cases, still somewhat high for 0-auto households but are very reasonable for other auto-ownership levels.

The relationships between the constants are logical. Both non-motorized and transit constants show decreasing attractiveness with increasing auto ownership, except for home-based-college trips where non-motorized travel is slightly more favored with 2 or more auto households than with 1-auto households. Drive access to transit generally is more attractive for households with more autos, except for journey-to-work—home-based-other, where households with 2+ autos are much less likely to use drive access, maybe because with 2 or more autos in a household, all workers are likely to have a car, and this makes it easier to drive directly to an intermediate stop to or from work. The other exception is for home-based-school trips, for which 1-auto households are much less likely to drive access than 0-auto households. This may be related to the unique nature of home-based-school trips, which probably have very little PNR activity at all. The KNR constants are very similar between 1 and 2+ auto ownership groups, with the exception of shopping trips, for which owning 2+ autos in a household makes KNR much less attractive. This is probably related to the need to haul shopping items in a car and not be relying on someone else for a pickup on the return trip.

The shared ride constants all show less attractiveness to share a ride with increasing auto ownership levels. The shared ride constants are negative, except for home-based-school, home-based-shopping, home-based-other, and non-work-related—non-home-based. This is consistent with the original calibration pattern.

The premium (i.e., express) transit constants are negative, except for the journey-at-work purposes, for which they are slightly positive. All were negative in the original calibration. The high frequency and good access to local service may present an attractive alternative to express service in many areas.

O‘ahu does not have rail in the base year 2005, so calculating a mode-specific constant for rail is not possible. Rail does not get more weight in the build scenario than other transit modes, therefore, does not have its own alternative specific constant applied to it.

The bike constant remains negative for all purposes, as walk dominates the non-motorized mode.

Table 3-86: Original Mode Choice Model Constants (AA Phase)

Purpose >	Journey-to/from-work (JTW)				Journey-at-work (JAW)		Non-work-related				
Constant V	HBW	HBNW	WB	NB	WB	NB	HBK12	HBCol	HBShp	HBOth	NHB
Level 1—Mode											
K0cbdTrn	1.305	2.716	0.25	0.25	0.25	0.25	-3.74	29.786	67.725	2.483	—
K0cbdAux	5.346	16.346	—	—	—	—	-3.397	87.097	67.888	17.43	—
K0othTrn	2.716	1.351	0.25	0.25	0.25	0.25	62.878	1.062	2.913	2.144	—
K0othAux	3.19	23.318	—	—	—	—	77.959	77.145	3.567	9.498	—
K0elsTrn	3.692	1.407	0.25	0.25	0.25	0.25	3.003	6.505	0.962	4.493	—
K0elsAux	9.09	46.961	—	—	—	—	66.297	66.229	3.614	26.541	—
K1cbdTrn	0.149	-0.756	-1.873	-1.538	-2.204	-2.542	1.064	1.728	-1.185	-1.397	-0.479
K1cbdAux	3.304	1.187	0.337	-0.196	4.84	77.065	33.335	-0.589	1.748	14.462	-0.383
K1othTrn	-0.801	-2.046	-2.3	-1.832	-2.354	-3.344	3.751	-3.868	-2.444	-0.878	-0.688
K1othAux	0.519	-0.762	-0.446	-0.505	0.008	-1.769	7.3	-1.717	-1.007	-0.333	-0.145
K1elsTrn	-0.925	-2.439	-3.253	-3.266	-3.024	-1.946	4.046	0.508	0.115	0.07	-0.45
K1elsAux	4.937	-0.39	-0.069	-0.647	1.272	-0.631	32.59	56.469	1.906	6.049	1.148
K2cbdTrn	-1.063	-2.75	0.25	0.25	0.25	0.25	0.038	-0.523	-1.784	-2.528	—
K2cbdAux	0.723	-1.872	—	—	—	—	-0.895	-0.623	-2.648	11.137	—
K2othTrn	-1.699	-2.689	0.25	0.25	0.25	0.25	-0.473	0.771	-0.944	-0.893	—
K2othAux	-0.516	-2.355	—	—	—	—	-0.008	0.443	0.055	0.498	—
K2elsTrn	-1.88	-3.656	0.25	0.25	0.25	0.25	0.827	-1.712	-2.954	-1.121	—
K2elsAux	0.965	-0.77	—	—	—	—	4.297	57.213	-0.879	2.215	—
Level 2—Highway Shared Ride											
K1sr	-0.924	-0.05	-1.23	0.098	-1.084	-0.416	3.488	-0.914	0.347	0.228	0.529
K2sr	-1.606	-0.183	—	—	—	—	1.589	-1.692	0.056	0.197	—
Level 3—Highway Shared Ride Occupancy											
Kocc3	-1.214	-0.449	-1.067	-0.616	-0.694	-1.026	0.325	-1.042	-0.227	-0.138	-0.057
Level 2—Transit Access											
K0dacc	-1.287	-1.249	-3.05	-3.05	-4.05	-2.05	-0.588	-1.793	-1.28	-1.841	—
K1dacc	3.919	2.155	27.263	1.483	5.204	1.675	-1.253	-0.298	0.39	0.539	3.366
K2dacc	17.187	-0.312	-1.3	-1.3	-2.3	-0.3	26.932	5.178	3.924	1.607	—
Level 3—Transit Walk Path											
Kgdwy	—	—	—	—	—	—	—	—	—	—	—
Kprem	-0.487	-1.163	-0.954	-0.929	-0.527	-0.595	-1.129	-1.505	-0.762	-1.134	-0.79
Level 3—Transit Drive Path											
K1Knr	-4.757	-2.529	-26.803	-2.145	-3.674	-1.662	-1.002	-1.531	-1.252	-1.595	-3.433
K2Knr	-17.61	-1.76	-0.15	0.75	0.75	-0.25	-27.235	-6.325	-3.595	-2.452	—
Level 2—Auxiliary Path											
Kauxb	-5.435	-44.147	-3.93	-5.539	-6.704	-80.107	-29.098	-58.261	-4.203	-15.955	-3.988

Table 3-87: New Mode Choice Model Constants with New Model Structure

New Calibrated Constants		Journey-to/from-work (JTW)				Journey-at-work (JAW)		Non-work-related				
Description	Variable Name	HBW	HBNW	WB	NB	WB	NB	HBK12	HBCol	HBShp	HBOth	NHB
		WH	WO	WW	WN	AW	AN	NK	NC	NS	NO	NN
3+Occupancy	Kocc3	-1.089	-0.441	-0.195	-0.5651	-.5261	-0.752	0.08	-0.98	-0.1642	-0.1113	-0.0556
1-Auto Shared Ride	K1sr	-0.856	-0.0581	-1.109	0.05746	-.7879	0.466	2.794	-0.927	0.3817	0.2868	0.5901
2+ Auto Shared Ride	K2sr	-1.456	-0.1742					1.291	-1.558	0.1342	0.2614	
Fixed Guideway	Kgdwy											
Premium (Express) Transit	Kprem	-0.794	-0.494	-0.964	-0.093			-1.209	-1.511			
1 Auto KNR	K1Knr	0.674	1.838	1.491	2.689	2.664	2.584	2.015	3.151	2.989	2.999	2.7480
2+ Auto KNR	K2Knr	0.949	2.093					1.753	1.719	2.967	2.968	
INFORMAL Park-and-ride	KPKnr	0.658	0.969	0.761	1.371	1.344	1.343	1.889	2.304	1.962	1.97	1.601
0-Auto Drive Access (all KNR)	K0dacc	-3.03	-2.886	-8.948	-7.675	-7.724	-7.699	-2.888	-4.004	-2.69	-2.719	-7.9780
1 Auto Drive Access	K1dacc	-2.701	-3.333					-4.12	-4.864	-5.38	-5.616	
2+ Auto Drive Access	K2dacc	-2.122	-5.697					-3.631	-3.477	-4.058	-4.962	
Bike share of non-motorized	Kauxb	-4.311	-7.398	-3.588	-4.734	-3.624	-4.145	15.977	-16.875	-4.109	-22.8	-3.211
0 Auto Transit	K0Trn	2.784	1.457	-1.449	-0.278	-1.482	3.233	1.782	7.194	2.295	2.397	-1.9100
1 Auto Transit	K1Trn	-0.292	-1.721					1.939	0.202	-1.222	-1.224	
2+ Auto Transit	K2Trn	-1.376	-2.546					0.114	-0.157	-2.597	-1.939	
0 Auto Non-Motorized	K0Aux	6.748	8.238	-0.163	-0.885	0.914	0.679	18.994	9.734	3.492	25.054	-0.2710
1 Auto Non-Motorized	K1Aux	2.647	-0.695					17.251	16.472	0.594	1.362	
2+ Auto Non-Motorized	K2Aux	0.304	-2.555					2.069	16.763	-2.418	0.445	

Changes to the nesting structure of the model to incorporate the toll and PNR changes from this document required calibration of additional nesting coefficients. Additional coefficients were needed to account for the change in how the wait time is used in mode choice. Table 3-88 shows the original mode choice coefficients and the nesting structure from the AA phase. Table 3-89 shows the re-calibrated mode choice coefficients that account for tolls and PNR changes.

The recalibrated model did an outstanding job estimating the mode choice shares as shown in Table 3-90. The only issue during the mode estimation was the journey-to-work—home-based-other purpose. It over-estimated the KNR by 8 to 16 percent.

Table 3-88: Original Mode Choice Coefficients from AA phase

Purpose	Journey To/From Work (JTW)				Journey At Work (JAW)		Non-Work Related (NWR)				
	HBW	HBNW	WB	NB	WB	NB	HBK12	HBCol	HBShp	HBOth	NHB
Coefficient	WH	WO	WW	WN	AW	AN	NK	NC	NS	NO	NN
Generic											
In-vehicle Time	-0.025	-0.025	-0.025	-0.025	-0.020	-0.020	-0.010	-0.025	-0.010	-0.010	-0.010
Walk time	-0.050	-0.050	-0.050	-0.050	-0.040	-0.040	-0.020	-0.050	-0.020	-0.020	-0.020
Wait time	-0.050	-0.050	-0.050	-0.050	-0.004	-0.004	-0.020	-0.050	-0.020	-0.020	-0.020
Cost	-0.004	-0.004	-0.004	-0.004	-0.005	-0.005	-0.008	-0.004	-0.008	-0.008	-0.008
Transfers	-0.025	-0.025	-0.025	-0.025	-0.020	-0.020	-0.010	-0.025	-0.010	-0.010	-0.010
Nesting Coefficient											
Access	0.447	0.447	0.447	0.447	0.447	0.447	0.447	0.447	0.447	0.447	0.447
Path	0.447	0.447	0.447	0.447	0.447	0.447	0.447	0.447	0.447	0.447	0.447
Lot	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Auto	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Occupancy	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Auxiliary	1	1	1	1	1	1	1	1	1	1	1

Table 3-89: Re-calibrated Mode Choice Coefficients for Draft EIS

	Purpose	Journey-to/from-work (JTW)				Journey-at-work (JAW)		Non-work-related				
		HBW	HBNW	WB	NB	WB	NB	HBK12	HBCol	HBShp	HBOth	NHB
	Coefficient	WH	WO	WW	WN	AW	AN	NK	NC	NS	NO	NN
Variable Relationships	**Generic**											
	In-vehicle Time	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	Walk time	2.0000	2.0000	2.0000	2.0000	2.0000	2.0000	2.0000	2.0000	2.0000	2.0000	2.0000
	Wait time	4.0000	4.0000	4.0000	4.0000	0.4000	0.4000	4.0000	4.0000	4.0000	4.0000	4.0000
	Cost	0.1680	0.1680	0.1680	0.1680	0.2500	0.2500	0.8400	0.1680	0.8400	0.8400	0.8400
	Transfers	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Proposed Values	**Generic**											
	In-vehicle Time	-0.0250	-0.0250	-0.0250	-0.0250	-0.0200	-0.0200	-0.0100	-0.0250	-0.0100	-0.0100	-0.0100
	Walk time	-0.0500	-0.0500	-0.0500	-0.0500	-0.0400	-0.0400	-0.0200	-0.0500	-0.0200	-0.0200	-0.0200
	1st Wait <5	-0.0500	-0.0500	-0.0500	-0.0500	-0.0400	-0.0400	-0.0200	-0.0500	-0.0200	-0.0200	-0.0200
	1st Wait >5	-0.0250	-0.0250	-0.0250	-0.0250	-0.0200	-0.0200	-0.0100	-0.0250	-0.0100	-0.0100	-0.0100
	Transfer Wait	-0.0500	-0.0500	-0.0500	-0.0500	-0.0400	-0.0400	-0.0200	-0.0500	-0.0200	-0.0200	-0.0200
	Cost	-0.0042	-0.0042	-0.0042	-0.0042	-0.0050	-0.0050	-0.0084	-0.0042	-0.0084	-0.0084	-0.0084
	Transfers	-0.0250	-0.0250	-0.0250	-0.0250	-0.0200	-0.0200	-0.0100	-0.0250	-0.0100	-0.0100	-0.0100
	Tolls	-0.0013	-0.0013	-0.0013	-0.0013	-0.0014	-0.0014	-0.001	-0.0026	-0.001	-0.001	-0.001
	Nesting Coefficient											
	Access	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
	Path	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	Lot	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	Auto	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
	Occupancy	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	Auxiliary	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
	Toll Drive Alone	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	Toll Share Ride	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
	Park-N-Ride	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
	Value of Time	3.57	3.57	3.57	3.57	2.40	2.40	0.71	3.57	0.71	0.71	0.71

Table 3-90: 2005 Observed versus Estimated Mode Shares

Journey-to-work—home-based-work (JTW-WH) Iteration= 30			
	OBS	EST	Diff
3+Occupancy	0.189	0.189	0.00
1-Auto Shared Ride	0.341	0.341	0.00
2+ Auto Shared Ride	0.194	0.194	0.00
Bike share of non-motorized	0.209	0.209	0.00
Premium (Express) Transit	0.103	0.101	0.00
1 Auto KNR	0.633	0.656	(0.02)
2+ Auto KNR	0.793	0.809	(0.02)
INFORMAL Park-and-ride	0.9	0.914	(0.01)
0-Auto Drive Access	0.023	0.023	0.00
1 Auto Drive Access	0.087	0.087	0.00
2+ Auto Drive Access	0.219	0.22	(0.00)
0 Auto Transit	0.485	0.485	0.00
1 Auto Transit	0.314	0.314	0.00
2+ Auto Transit	0.139	0.138	0.00
0 Auto Non-Motorized	0.126	0.126	0.00
1 Auto Non-Motorized	0.074	0.073	0.00
2+ Auto Non-Motorized	0.033	0.033	0.00

Journey-to-work—work-based (JTW-WW) Iteration= 19			
	OBS	EST	Diff
3+Occupancy	0.214	0.214	0.00
1-Auto Shared Ride	0.255	0.255	0.00
2+ Auto Shared Ride	0.01	0	0.01
Bike share of non-motorized	0.064	0.064	0.00
Premium (Express) Transit	0.031	0.031	0.00
1 Auto KNR	0.99	0.988	0.00
2+ Auto KNR	0.01	0	0.01
INFORMAL Park-and-ride	0.99	0.96	0.03
0-Auto Drive Access	0.01	0	0.01
1 Auto Drive Access	0.001	0	0.00
2+ Auto Drive Access	0.01	0	0.01
0 Auto Transit	0.01	0	0.01
1 Auto Transit	0.01	0	0.01
2+ Auto Transit	0.052	0.052	0.00
0 Auto Non-Motorized	0.071	0.071	0.00
1 Auto Non-Motorized	0.01	0	0.01
2+ Auto Non-Motorized	0.01	0	0.01

Journey-to-work—home-based-other (JTW-WO) Iteration= 8			
	OBS	EST	Diff
3+Occupancy	0.378	0.378	0.00
1-Auto Shared Ride	0.613	0.613	0.00
2+ Auto Shared Ride	0.58	0.58	0.00
Bike share of non-motorized	0.15	0.161	(0.01)
Premium (Express) Transit	0.097	0.091	0.01
1 Auto KNR	0.8	0.963	(0.16)
2+ Auto KNR	0.9	0.984	(0.08)
INFORMAL Park-and-ride	0.99	0.987	0.00
0-Auto Drive Access	0.036	0.023	0.01
1 Auto Drive Access	0.118	0.178	(0.06)
2+ Auto Drive Access	0.005	0.012	(0.01)
0 Auto Transit	0.232	0.243	(0.01)
1 Auto Transit	0.45	0.422	0.03
2+ Auto Transit	0.025	0.027	(0.00)
0 Auto Non-Motorized	0.043	0.043	0.00
1 Auto Non-Motorized	0.01	0.01	0.00
2+ Auto Non-Motorized	0.017	0.017	0.00

Journey-to-work—non-home-based (JTW-WN) Iteration= 19			
	OBS	EST	Diff
3+Occupancy	0.323	0.323	0.00
1-Auto Shared Ride	0.633	0.633	0.00
2+ Auto Shared Ride	0.01	0	0.01
Bike share of non-motorized	0.01	0.01	0.00
Premium (Express) Transit	0.072	0.072	0.00
1 Auto KNR	0.99	0.992	(0.00)
2+ Auto KNR	0.01	0	0.01
INFORMAL Park-and-ride	0.99	0.994	(0.00)
0-Auto Drive Access	0.01	0	0.01
1 Auto Drive Access	0.001	0.002	(0.00)
2+ Auto Drive Access	0.01	0	0.01
0 Auto Transit	0.01	0	0.01
1 Auto Transit	0.01	0	0.01
2+ Auto Transit	0.081	0.081	0.00
0 Auto Non-Motorized	0.038	0.038	0.00
1 Auto Non-Motorized	0.01	0	0.01
2+ Auto Non-Motorized	0.01	0	0.01

Table 3-90: 2005 Observed versus Estimated Mode Shares (continued)

Journey-at-work—work-based (JAW-AW) Iteration= 19			
	OBS	EST	Diff
3+Occupancy	0.284	0.284	0.00
1-Auto Shared Ride	0.264	0.264	0.00
2+ Auto Shared Ride	0.01	0	0.01
Bike share of non-motorized	0.038	0.038	0.00
Premium (Express) Transit	0.001	0	0.00
1 Auto KNR	0.99	0.993	(0.00)
2+ Auto KNR	0.01	0	0.01
INFORMAL Park-and-ride	0.99	0.993	(0.00)
0-Auto Drive Access	0.01	0	0.01
1 Auto Drive Access	0.001	0.002	(0.00)
2+ Auto Drive Access	0.01	0	0.01
0 Auto Transit	0.01	0	0.01
1 Auto Transit	0.01	0	0.01
2+ Auto Transit	0.027	0.027	0.00
0 Auto Non-Motorized	0.258	0.258	0.00
1 Auto Non-Motorized	0.01	0	0.01
2+ Auto Non-Motorized	0.01	0	0.01

Non-work-related—home-based-school (NK) Iteration= 4			
	OBS	EST	Diff
3+Occupancy	0.624	0.624	0.00
1-Auto Shared Ride	0.993	0.993	0.00
2+ Auto Shared Ride	0.939	0.939	0.00
Bike share of non-motorized	0.1	0.119	(0.02)
Premium (Express) Transit	0.027	0.026	0.00
1 Auto KNR	0.863	0.868	(0.01)
2+ Auto KNR	0.753	0.761	(0.01)
INFORMAL Park-and-ride	0.99	0.994	(0.00)
0-Auto Drive Access	0.029	0.029	0.00
1 Auto Drive Access	0.065	0.066	(0.00)
2+ Auto Drive Access	0.093	0.094	(0.00)
0 Auto Transit	0.184	0.208	(0.02)
1 Auto Transit	0.65	0.604	0.05
2+ Auto Transit	0.06	0.064	(0.00)
0 Auto Non-Motorized	0.378	0.332	0.05
1 Auto Non-Motorized	0.058	0.058	0.00
2+ Auto Non-Motorized	0.178	0.178	0.00

Journey-at-work—non-home-based (JAW-AN) Iteration= 19			
	OBS	EST	Diff
3+Occupancy	0.203	0.203	0.00
1-Auto Shared Ride	0.421	0.421	0.00
2+ Auto Shared Ride	0.01	0	0.01
Bike share of non-motorized	0.01	0.01	0.00
Premium (Express) Transit	0.001	0	0.00
1 Auto KNR	0.99	0.99	0.00
2+ Auto KNR	0.01	0	0.01
INFORMAL Park-and-ride	0.99	0.993	(0.00)
0-Auto Drive Access	0.01	0	0.01
1 Auto Drive Access	0.001	0.001	0.00
2+ Auto Drive Access	0.01	0	0.01
0 Auto Transit	0.01	0	0.01
1 Auto Transit	0.01	0	0.01
2+ Auto Transit	0.452	0.452	0.00
0 Auto Non-Motorized	0.104	0.104	0.00
1 Auto Non-Motorized	0.01	0	0.01
2+ Auto Non-Motorized	0.01	0	0.01

Non-work-related—home-based-college (NC) Iteration= 30			
	OBS	EST	Diff
3+Occupancy	0.229	0.229	0.00
1-Auto Shared Ride	0.362	0.362	0.00
2+ Auto Shared Ride	0.185	0.185	0.00
Bike share of non-motorized	0.46	0.49	(0.03)
Premium (Express) Transit	0.041	0.048	(0.01)
1 Auto KNR	0.99	0.985	0.01
2+ Auto KNR	0.671	0.569	0.10
INFORMAL Park-and-ride	0.99	0.995	(0.01)
0-Auto Drive Access	0.009	0.009	0.00
1 Auto Drive Access	0.084	0.097	(0.01)
2+ Auto Drive Access	0.101	0.117	(0.02)
0 Auto Transit	0.85	0.853	(0.00)
1 Auto Transit	0.14	0.137	0.00
2+ Auto Transit	0.18	0.185	(0.01)
0 Auto Non-Motorized	0.122	0.108	0.01
1 Auto Non-Motorized	0.143	0.147	(0.00)
2+ Auto Non-Motorized	0.091	0.08	0.01

Table 3-90: 2005 Observed versus Estimated Mode Shares (continued)

Non-work-related—home-based-shopping (NS) Iteration= 19			
	OBS	EST	Diff
3+Occupancy	0.425	0.425	0.00
1-Auto Shared Ride	0.695	0.695	0.00
2+ Auto Shared Ride	0.618	0.618	0.00
Bike share of non-motorized	0.078	0.078	0.00
Premium (Express) Transit	0.001	0	0.00
1 Auto KNR	0.99	0.99	0.00
2+ Auto KNR	0.99	0.99	0.00
INFORMAL Park-and-ride	0.99	0.994	(0.00)
0-Auto Drive Access	0.036	0.036	0.00
1 Auto Drive Access	0.054	0.053	0.00
2+ Auto Drive Access	0.271	0.268	0.00
0 Auto Transit	0.257	0.257	0.00
1 Auto Transit	0.511	0.511	0.00
2+ Auto Transit	0.033	0.033	0.00
0 Auto Non-Motorized	0.1	0.1	0.00
1 Auto Non-Motorized	0.012	0.012	0.00
2+ Auto Non-Motorized	0.019	0.019	0.00

Non-work-related—home-based-other (NO) Iteration= 19			
	OBS	EST	Diff
3+Occupancy	0.454	0.454	0.00
1-Auto Shared Ride	0.673	0.673	0.00
2+ Auto Shared Ride	0.665	0.665	0.00
Bike share of non-motorized	0.091	0.103	(0.01)
Premium (Express) Transit	0.006	0	0.01
1 Auto KNR	0.99	0.99	0.00
2+ Auto KNR	0.99	0.99	0.00
INFORMAL Park-and-ride	0.99	0.994	(0.00)
0-Auto Drive Access	0.036	0.036	0.00
1 Auto Drive Access	0.04	0.039	0.00
2+ Auto Drive Access	0.094	0.092	0.00
0 Auto Transit	0.278	0.3	(0.02)
1 Auto Transit	0.547	0.512	0.04
2+ Auto Transit	0.032	0.032	0.00
0 Auto Non-Motorized	0.13	0.13	0.00
1 Auto Non-Motorized	0.017	0.017	0.00
2+ Auto Non-Motorized	0.071	0.071	0.00

Non-work-related—non-home-based (NN) Iteration=19			
	OBS	EST	Diff
3+Occupancy	0.481	0.481	0.00
1-Auto Shared Ride	0.75	0.75	0.00
2+ Auto Shared Ride	0.01	0	0.01
Bike share of non-motorized	0.048	0.048	0.00
Premium (Express) Transit	0.004	0	0.00
1 Auto KNR	0.99	0.991	(0.00)
2+ Auto KNR	0.01	0	0.01
INFORMAL Park-and-ride	0.99	0.993	(0.00)
0-Auto Drive Access	0.01	0	0.01
1 Auto Drive Access	0.001	0.001	0.00
2+ Auto Drive Access	0.01	0	0.01
0 Auto Transit	0.01	0	0.01
1 Auto Transit	0.01	0	0.01
2+ Auto Transit	0.01	0.01	0.00
0 Auto Non-Motorized	0.105	0.105	0.00
1 Auto Non-Motorized	0.01	0	0.01
2+ Auto Non-Motorized	0.01	0	0.01

3.8 Adjustment of KNR/PNR Trips by Purpose (San Diego Method)

The model was estimating total PNR and KNR trips correctly to rail but the proportion of PNR to KNR trips in mode choice was overwhelmingly favoring KNR to rail. As mentioned previously, O‘ahu travelers do not have satisfaction with the current PNR locations, but it is anticipated that travelers will experience an increase in security and convenience for parking in a lot at a rail station once the system is in place.

For Honolulu, there was no data to suggest the proper split of these trips to rail since rail does not exist. In order to calibrate the actual mode shares to be able to produce accurate mode of access into the stations, the proportion needed to be adjusted.

Data for various rail systems around the country were compiled in order to determine which PNR/KNR characteristics most appropriately reflected the anticipated mode split in Honolulu. Table 3-91 shows the comparison by purpose for each system.

The decision was made to use the percentages by trip purpose from the San Diego rail line survey because it produced the most conservative estimate of the mode split. The San Diego travel patterns are more closely related to those in O‘ahu as well. The share percentages in Table 3-91 were used to re-estimate and balance trips in mode choice so that the correct trip proportions are made to KNR and PNR by the varying auto ownership levels. The shares needed to achieve the same percentages as San Diego by mode/purpose for O‘ahu are shown in Table 3-92.

A set of new constants by auto ownership were calibrated for mode choice and are applied by iterating once at the end of the mode choice model. The constant changes are located in the PPF1##ub.ctl file, where ## is the trip purpose. The journey-to-work—home-based-work control file (ppf1whub.ctl) is displayed in Appendix A. The calibrated constants are shown below in Table 3-93.

The original model did not understand how the future year drive access to rail would change based on the perception people have of the security and ease of use of the formal PNR and KNR locations for rail. The shift of people from predominantly KNR in the base year to a more even match is proven by the other areas discussed in this section. The model was then calibrated based on the San Diego percentages and the KNR constant was not allowed to become negative (basically not allowing the trips to decrease) so it allowed for people to understand the effects of rail service in the area and increased the number of drive access to rail trips.

This adjustment brought KNR to rail from 23,093 trips (0.7 percent) to 17,918 trips (0.5 percent) overall. The PNR increased from 4,456 trips (0.1 percent) to 17,748 (0.5 percent). Overall, there is better balance of trips by access mode. Table 3-94 shows the mode choice results by purpose as a result of the implementation of the San Diego method. Overall, the total drive access percentage increased by 7 percent using the San Diego method as compared to the original model output as shown in Table 3-95.

Table 3-96 shows the adjusted mode of access with the San Diego Method. Table 3-97 shows the unadjusted mode of access.

Table 3-91: Park-and-ride Shares by Purpose for Other Rail Systems

	Walk	Bus	Park-and-Ride	Kiss-and-Ride	Total	Walk	Bus	Park-and-Ride	Kiss-and-Ride
Home-based-work									
Salt Lake	4,108		7,222	130	11,460	35.8%		63.0%	1.1%
San Diego	34939		6716	1828	43,483	80.4%		15.4%	4.2%
Portland	10,290	2,555	10,753	1,777	25,375	40.6%	10.1%	42.4%	7.0%
Baltimore	30,117		9,481	1,738	41,337	72.9%		22.9%	4.2%
Los Angeles	26,728	43,660	16,988	4,264	91,640	29.2%	47.6%	18.5%	4.7%
Home-based-non-work									
Salt Lake	2,489		1,951	48	4,488	55.5%		43.5%	1.1%
San Diego	21,621		1,909	312	23,842	90.7%		8.0%	1.3%
Portland	9,437	2,730	4,837	1,125	18,129	52.1%	15.1%	26.7%	6.2%
Baltimore	15,231		3,587	742	19,560	77.9%		18.3%	3.8%
Los Angeles	16,031	21,251	2,027	1,122	40,431	39.7%	52.6%	5.0%	2.8%
Home-based-college									
Salt Lake	1,313		2,514	169	3,996	32.9%		62.9%	4.2%
San Diego	4,650		45	105	4,799	96.9%		0.9%	2.2%
Portland	NA		NA	NA	NA	NA		NA	NA
Baltimore	1,919		341	57	2,317	82.8%		14.7%	2.4%
Los Angeles	4,397	8,292	468	740	13,897	31.6%	59.7%	3.4%	5.3%
Non-home-based									
Salt Lake	3,903		201	144	4,248	91.9%		4.7%	3.4%
San Diego	14,214		2,772		16,986	83.7%		16.3%	0.0%
Portland	9,968	1,380	1,605	569	13,522	73.7%	10.2%	11.9%	4.2%
Baltimore	5,753		1,194	353	7,300	78.8%		16.4%	4.8%
Los Angeles	6,641	5,684	673	492	13,490	49.2%	42.1%	5.0%	3.6%

Table 3-92: Shares Needed by Access in Honolulu to Replicate San Diego Rail percentages

	Auto Owner-ship Level	journey-to-work—home-based-work	journey-to-work—home-based-other	journey-to-work—non-based	journey-to-work—work-based	journey-at-work—work-based	journey-at-work—non-based	non-work-related—home-based-school (K-12)	non-work-related—home-based-college	non-work-related—home-based-shopping	non-work-related—home-based-other	non-work-related—non-home-based
		WH	WO	WN	WW	AW	AN	NK	NC	NS	NO	NN
Total Drive Access	0	4.83%	5.72%	N/A	N/A	N/A	N/A	4.31%	1.16%	8.22%	7.49%	N/A
	1	19.24%	30.35%					12.88%	21.38%	12.25%	10.16%	
	2+	40.91%	2.12%					17.74%	24.01%	48.19%	21.40%	
Park-and-Ride	0	—	—					—	—	—	—	
	1	13.81%	27.83%					0.00%	12.64%	12.25%	0.00%	
	2+	34.71%	1.96%					0.00%	17.23%	47.48%	21.40%	
Kiss-and-Ride	0	4.83%	5.72%					4.31%	1.16%	8.22%	7.49%	
	1	5.43%	2.52%					12.88%	8.74%	0.00%	10.16%	
	2+	6.20%	0.16%					17.74%	6.78%	0.71%	0.00%	

Table 3-93: Calibrated Park-and-ride/Kiss-and-ride Constants for Honolulu

	Auto Owner-ship Level	journey-to-work—home-based-work	journey-to-work—home-based-other	journey-to-work—non-based	journey-to-work—work-based	journey-at-work—work-based	journey-at-work—non-based	non-work-related—home-based-school (K-12)	non-work-related—home-based-college	non-work-related—home-based-shopping	non-work-related—home-based-other	non-work-related—non-home-based	Parameter Name in Control File
		WH	WO	WN	WW	AW	AN	NK	NC	NS	NO	NN	
Park-and-Ride	0	0.00	0.00	0.00	N/A	N/A	N/A	0.00000	0	0	0	N/A	K0gdpnr
	1	1.00	1.37	3.32				0.00000	4.83962	4.82978	4.592		K1gdpnr
	2+	2+	1.89	3.30				0.00000	1.83359	5.02858	4.5395		K2gdpnr
Kiss-and-Ride	0	0.00	0.00	0.00				0	0	0	0		K0gdknr
	1	1.00	0.00	0.00				0.06081	0	0	0		K1gdknr
	2+	2+	0.00	0.00				0.12513	0.07705	0	0		K2gdknr

Table 3-94: Mode Choice Comparison with/without Using San Diego Mode Shares

	journey-to-work—home-based-work WH	journey-to-work—home-based-other WO	journey-to-work—non-based WN	journey-to-work—work-based WW	journey-at-work—work-based AW	journey-at-work—non-based AN	non-work-related—home-based-school (K-12) NK	non-work-related—home-based-college NC	non-work-related—home-based-shopping NS	non-work-related—home-based-other NO	non-work-related—non-home-based NN	*Total*	% of Trips
2030 MOS J FTA run 3/17/09 with San Diego Method													
1-occ	361,659	75,110	26,514	125,055	109,611	2,994	8,965	31,140	83,695	258,663	111,827	***1,195,233***	34.6%
2-occ	92,202	67,779	30,713	33,113	28,272	1,732	70,671	6,564	91,931	290,364	174,806	***888,147***	25.7%
3+occ	21,738	40,754	14,662	9,304	11,191	397	112,689	1,856	67,919	241,552	161,826	***683,888***	19.8%
wk-prem	918	65	115	37	—	—	30	12	—	—	—	***1,177***	0.0%
wk-ngdw	50,106	4,749	5,379	7,099	4,659	4,776	16,893	8,716	10,393	29,508	4,487	***146,765***	4.3%
wk-gdwy	35,290	2,003	2,005	5,887	1,135	661	3,712	8,283	1,547	8,946	910	***70,379***	2.0%
drv-pnr	14,472	220	—	—	—	—	207	1,588	466	795	—	***17,748***	0.5%
drv-knr	11,287	328	—	—	—	—	1,723	1,859	826	1,887	—	***17,910***	0.5%
aux-w	49,495	9,672	2,959	12,367	49,831	1,208	63,671	4,467	28,251	113,963	48,409	***384,293***	11.1%
aux-b	11,619	1,795	1	830	2,037	—	9,342	4,139	2,262	12,640	2,493	***47,158***	1.4%
Totals	***648,786***	***202,475***	***82,348***	***193,692***	***206,736***	***11,768***	***287,903***	***68,624***	***287,290***	***958,318***	***504,758***	***3,452,698***	***100.0%***
2030 MOS J FTA run 3/17/09 without San Diego Method													
1-occ	364,706	75,147	26,514	125,055	109,611	2,994	8,966	31,377	83,789	258,784	111,827	***1,198,770***	34.7%
2-occ	93,020	67,822	30,713	33,113	28,272	1,732	70,683	6,630	92,032	290,493	174,806	***889,316***	25.8%
3+occ	22,003	40,802	14,662	9,304	11,191	397	112,717	1,881	67,984	241,669	161,826	***684,436***	19.8%
wk-prem	919	65	115	37	—	—	30	12	—	—	—	***1,178***	0.0%
wk-ngdw	50,324	4,757	5,379	7,099	4,659	4,776	16,905	8,736	10,443	29,596	4,487	***147,161***	4.3%
wk-gdwy	37,345	2,035	2,005	5,887	1,135	661	3,727	8,585	1,578	9,012	910	***72,880***	2.1%
drv-pnr	3,562	—	—	—	—	—	218	676	—	—	—	***4,456***	0.1%
drv-knr	15,755	419	—	—	—	—	1,637	2,138	967	2,177	—	***23,093***	0.7%
aux-w	49,502	9,672	2,959	12,367	49,831	1,208	63,671	4,467	28,251	113,963	48,409	***384,300***	11.1%
aux-b	11,630	1,795	1	830	2,037	—	9,343	4,142	2,262	12,640	2,493	***47,173***	1.4%
Totals	***648,766***	***202,514***	***82,348***	***125,055***	***206,736***	***11,768***	***287,897***	***68,644***	***287,306***	***958,334***	***504,758***	***3,452,763***	***100.0%***

Table 3-95: Model Comparison of Home-based Purposes Rail Access with and without San Diego Drive Access Percentages

Mode	0 Auto Trips	1 Auto Trip	2+ Auto Trips	Total	
wk-gdwy	18026	19130	25198	62354	76.50%
pnr-gdwy	0	962	2450	3412	4.19%
pnr-expr	0	13	29	42	
pnr-locl	0	351	775	1126	
knr-gdwy	1073	3394	11280	15747	19.32%
knr-expr	44	40	140	224	
knr-locl	886	1839	4487	7212	
tot-gdwy	19096	23485	38928	81509	100.00%
inf-gdwy	0	807	2090	2897	84.91%
inf-expr	0	9	20	29	
inf-locl	0	299	696	995	
% drv acc gdwy	5.62%	18.55%	35.27%	23.51%	
Total Drive to Rail					***23.51%***

Mode	0 Auto Trips	1 Auto Trip	2+ Auto Trips	Total	
wk-gdwy	18026	18436	23401	59863	69.00%
pnr-gdwy	0	3647	12420	16067	18.52%
pnr-expr	0	14	29	43	
pnr-locl	0	515	1253	1768	
knr-gdwy	1073	2417	7338	10828	12.48%
knr-expr	44	40	140	224	
knr-locl	886	1788	4328	7002	
tot-gdwy	19096	24501	43159	86756	100.00%
inf-gdwy	0	622	1373	1995	12.42%
inf-expr	0	9	20	29	
inf-locl	0	299	696	995	
% drv acc gdwy	5.62%	24.75%	45.78%	31.00%	
Total Drive to Rail					***31.00%***

Table 3-96: Mode of Access Using San Diego Method

Station	Person Trips In						Person Trips Out		
	Walk	Bus	KNR	Formal PNR	Informal PNR	Total	Walk	Bus	Total
East Kapolei	577	8137	759	2855	0	12328	271	1742	2013
UH West O'ahu	635	7898	510	1354	0	10397	944	549	1493
Ho'opili	2341	171	462	0	98	3072	293	7	300
West Loch	843	5894	1006	0	225	7968	856	1409	2265
Waipahu Transit Center	652	2970	456	0	90	4168	578	1230	1808
Leeward Community College	437	0	79	0	16	532	2894	0	2894
Pearl Highlands	2356	9306	1184	6222	0	19068	924	823	1747
Pearlridge	341	6021	468	0	113	6943	1655	2730	4385
Aloha Stadium (Kamehameha Highway)	486	1102	218	3223	0	5029	1544	996	2540
Pearl Harbor	905	1305	261	0	59	2530	4363	2268	6631
Airport	807	1138	86	0	22	2053	8287	490	8777
Lagoon Drive	421	2020	193	0	47	2681	1762	1127	2889
Middle Street	189	2232	274	0	65	2760	1151	1493	2644
Kalihi	1317	715	397	0	94	2523	3440	67	3507
Kapālama	547	0	112	0	19	678	2741	0	2741
Iwilei	453	1637	1030	0	243	3363	1537	1378	2915
Chinatown	861	0	16	0	0	877	1894	0	1894
Downtown	618	4202	21	0	0	4841	11285	2497	13782
Civic Center	1274	0	66	0	1	1341	5165	4	5169
Kaka'ako	1080	79	36	0	0	1195	4003	272	4275
Ala Moana Center	1005	8341	1772	0	504	11622	7742	23558	31300
Total	***18145***	***63168***	***9406***	***13654***	***1596***	***105969***	***63329***	***42640***	***105969***
	17%	60%	9%	13%	2%	100%			

Table 3-97: Mode of Access without San Diego Method Implementation Station

Station	Person Trips In						Person Trips Out		
	Walk	Bus	KNR	Formal PNR	Informal PNR	Total	Walk	Bus	Total
East Kapolei	611	8514	1578	138	0	10841	262	1708	1970
UH West O'ahu	670	8142	958	61	0	9831	921	512	1433
Ho'opili	2416	221	774	0	234	3645	296	7	303
West Loch	866	6254	1588	0	487	9195	768	1309	2077
Waipahu Transit Center	669	3175	702	0	212	4758	494	1187	1681
Leeward Community College	449	0	152	0	43	644	2811	0	2811
Pearl Highlands	2488	9278	2389	200	0	14355	927	809	1736
Pearlridge	351	6262	750	0	237	7600	1478	2464	3942
Aloha Stadium (Kamehameha Highway)	501	1151	392	76	0	2120	1523	981	2504
Pearl Harbor	913	1340	431	0	125	2809	4194	2072	6266
Airport	807	1170	123	0	35	2135	7928	447	8375
Lagoon Drive	421	2058	265	0	82	2826	1743	1054	2797
Middle Street	190	2252	334	0	84	2860	1120	1350	2470
Kalihi	1317	732	457	0	125	2631	3205	66	3271
Kapālama	546	0	122	0	28	696	2609	0	2609
Iwilei	453	1633	1089	0	268	3443	1473	1273	2746
Chinatown	861	0	17	0	0	878	1822	0	1822
Downtown	618	4224	20	0	0	4862	10712	2324	13036
Civic Center	1274	0	65	0	1	1340	4871	6	4877
Kaka'ako	1080	78	35	0	0	1193	3846	277	4123
Ala Moana Center	1005	8347	1770	0	510	11632	7370	22075	29445
Total	**18506**	**64831**	**14011**	**475**	**2471**	**100294**	**60373**	**39921**	**100294**
	18%	65%	14%	0.5%	2.5%	100%			

Appendix A—Mode Choice Control Sample File (journey-to-work—home-based-work purpose only—ppf1whub.ctl)

```
OMPO Travel Forecasting Model Development Project
Purpose JTW-HBW (code wh)

andfiles
 title  = 'OMPO MC JTW-HBW (wh)'
 Fzdata = '..\zd\zdxxxxtc.msj'
 Fsdata = '..\trn\acc\alxxxxsd.msj'
 Ftends = '..\tg\pexxppxx.msj'
 Ftrper = '..\td\ppxxwhxx.msj'
 Fskoc1 = '..\hwy\skpkxxo1.msj'
 Fskoc2 = '..\hwy\skpkxxo2.msj'
 Fskoc3 = '..\hwy\skpkxxo3.msj'
 Fskwn  = '..\trn\skamxxwl.msj'
 Fskwp  = '..\trn\skamxxwp.msj'
 Fskwg  = '..\trn\skamxxfg.msj'
 Fskpr  = '..\trn\skamxxpr.msj'
 Fskkr  = '..\trn\skamxxkr.msj'
 Fskaw  = '..\axl\skxxxxwk.msj'
 Fskab  = '..\axl\skxxxxbk.msj'
 Frpt   = 'ppxxwhmm_10.rpt'
 Ftrmc  = 'ppxxwhmm.msj'
 Flsqos = 'lsxxwhmc.msj'
 Flsdst = 'lsxxwhvo.msj'
 Fdequiv = '..\..\GENERIC\VIS\26dequiv.dat'
 fuserbn= 'userbwh.msj'
andend
andparams
 nzones  = 764
 period  = 1
 nzdata  = 5
 nsdata  = 5
 toler   = 0.01
 mxiter  = 1
 calwgt  = 2.0
 lsoffset= 10.0
 lsscale = 650.0
 pttab   = 1,2,3
 tollmdl = f
 sllimit = 500
 Scale   = 1
 tpurp   = 'jtw-wh'
 tday    = 'peak '
 altname = 'alternative msj'
 mfgsta  = 4000
andend
andoptions
 dryrun  = f
 debug   = f
 calib   = f
 Tijonly = F
 geo     = f
 pnrknr  = t
 dacc    = t
 noprem  = f
 nopnr   = f
 noknr   = f
 firstw  = t
 senst   = f
 fmatch  = f
 noinfp  = f
andend
```

```
andselects
  i      = 1,-764
  j      = 1,-764
  reports = 1,-3
  nfprods = 1,2,3
  userben = t
andend
andparms
  adistfctr(1) =0.267
  DCpm    = 12.0

  Civt    = -0.0250
  Cwalkt  = -0.0500
  cwaitt  = -0.0500
  Ccost   = -0.0042
  Cdrat   =  0.0000
  Clwaitt = -0.0250

  Ctsav   =  0.000
  Ctdst   =  0.000
  Ctout   =  0.000
  Ctoll   = -0.0013

  Clsacc  =  0.700
  Clspath =  0.500
  Clslot  =  0.500
  Clsauto =  0.700
  Clsocc  =  0.500
  Clsaux  =  0.700
  ClsTollda =  0.500
  ClsTollsr =  0.900
  Clspnr  =  0.750
  xferwt  =  248

  izda    =  0.5280
  izsr2   =  0.0941
  izsr3   =  0.1128
  izwalk  =  0.2503
  izbike  =  0.0148

  Kocc3 =    -1.089
  K1sr  =    -.856
  K2sr  =    -1.456
  Kprem =    -.794
  K1Knr =     .674
  K2Knr =     .949
  KPKnr =     .658
  K0dacc =   -3.030
  K1dacc =   -2.701
  K2dacc =   -2.122
  Kauxb =    -4.311
  K0Trn =     2.784
  K1Trn =    -.292
  K2Trn =    -1.376
  K0Aux =     6.748
  K1Aux =     2.647
  K2Aux =      .304

  Socc3   =  0.189

  S1sr    =  0.341
  S2sr    =  0.194
  Sgdwy   =  0.000
  Sprem   =  0.103
  S1knr   =  0.633
  S2knr   =  0.793
  Sknr    =  0.758
  S0dacc  =  0.023
  S1dacc  =  0.087
  S2dacc  =  0.219
```

```
Sinfl   = 0.900
  S0Trn   = 0.485
  S1Trn   = 0.139
  S2Trn   = 0.074
  S0Aux   = 0.314
  S1Aux   = 0.126
  S2Aux   = 0.033
  S0cbdtrn = 0.560
  S0othtrn = 0.676
  S0elstrn = 0.660
  S1cbdtrn = 0.399
  S1othtrn = 0.163
  S1elstrn = 0.082
  S2cbdtrn = 0.217
  S2othtrn = 0.090
  S2elstrn = 0.045

  Sauxb   = 0.209

  S0cbdaux = 0.224
  S0othaux = 0.224
  S0elsaux = 0.224
  S1cbdaux = 0.122
  S1othaux = 0.122
  S1elsaux = 0.122
  S2cbdaux = 0.033
  S2othaux = 0.033
  S2elsaux = 0.033
  S0gdpnr  = 0.000
  S1gdpnr  = 0.1381
  S2gdpnr  = 0.3471
  S0gdknr  = 0.0483
  S1gdknr  = 0.0543
  S2gdknr  = 0.0620
  K0gdpnr  = 0.000
  K1gdpnr  = 1.37474
  K2gdpnr  = 1.89467
  K0gdknr  = 0
  K1gdknr  = 0
  K2gdknr  = 0
andend
```